NEW ORDNANCE MATERIAL.*

Official Report to the U. S. War Department.

BY WM. H. BIXBY, CAPT. OF ENG'S., U. S. ARMY.

(*Continued from page 370.*)

New Explosives.

Gruson new explosive of 1881.[1]—During the writer's visit to Magdeburg he had the opportunity of examining a new explosive which seems especially adapted to all military purposes, wherever a safe but violent explosive is required.

This explosive is composed of two ingredients which can be transported with perfect safety, are mixed only for use, and can be re-separated with ease at any subsequent moment. It is more powerful than nitro-glycerine, safer than dynamite, produces no unpleasant effects upon those who handle it, and is cheap.

In 1881-2, it was being tried by the German Government, but as usual all results were kept secret.

The composition of this explosive is still kept partially secret. One ingredient is strong nitric acid, and the other is a crystal; it is impossible to explode either alone, so that they are both perfectly safe as regards transportation.

In order to make use of the explosive, the crystals are placed in the nitric acid where they dissolve rapidly with a slight reduction of temperature; there is no chemical combination but only a solution in this case; the mixture is then ready for use, but cannot be exploded by any ordinary method; for explosion it requires the use of a fulminating or detonating fuse, twice as powerful as that used to explode dynamite. If by any chance after being thus prepared the mixture is not required for immediate use, the addition of a little water dilutes the nitric acid to such an extent that the other ingredient is no longer held in solution; the crystals re-form, and can be separated by simply straining the mixture; the crystals are then dried (without the slightest danger), and are ready to be used again; the nitric acid is left in its diluted state and sold or used for other purposes.

If the crystals are heated to a high degree of temperature they burn without explosion somewhat like sealing wax; neither ingredient alone, nor the mixture, can be frozen at any temperature above zero Fahrenheit. Neither the crystals, nor the mixture, produce any other unpleasant effects on the presons who handle them, except the usual effect produced by nitric acid.

The nitric acid is strong but not fuming, yellow in color, and very pure.

The crystalline ingredient of this new explosive is Mr. Gruson's secret; it is a substance well known, to whose transportation there is no objection; it is in fact often transported today in commerce; it is not soluble in water, does not absorb water, and never becomes damp. Mr. Gruson discovered this explosive while experimenting to find some economical method for breaking up his old iron chills. He thinks he has such facilities for its manufacture as will allow him to make it cheaper than other people.

In order to allow of the use of this explosive within projectiles, Mr. Gruson manufactures two varieties of shells, each containing two compartments connected by a truncated conical opening, this opening being ordinarily filled by a solid conical plug. The liquid nitric acid is placed in the cavity on the side of the larger base of this conical plug, the cavity being lined with glass; the crystalline ingredient is placed in the other cavity on the side of the smaller base of the conical plug.

If the shell is desired to explode when the shot strikes, the shell is made to contain at its forward end a percussion fuse opening into the first cavity containing the crystalline powder; the conical opening above described connects this first cavity to the second cavity containing the nitric acid within its thin glass case, the conical opening being so placed that its plug has its larger base toward the rear of the projectile. When the gun is fired, inertia forces the conical plug out from its cavity into the compartment containing the nitric acid, and the two components of the explosives are mixed thoroughly by the rotation of the shell during its flight: the explosive is then ready to be exploded by the percussion fuse at the moment that the shot strikes any resisting object.

In other shells where it is desired that the shot should explode at a certain time after striking, the shot contains at its rear a chemical fuse connecting with the cavity containing the crystalline powder; in front of this latter is the compartment containing the nitric acid within its glass envelope; the conical opening connecting the two compartments is placed with the larger base of the conical plug turned toward the front, so that the plug cannot be disturbed from its position by any sudden forward movement of the projectile. When the shot strikes, the plug and the crystalline powder in its rear are driven by their inertia into the nitric acid; the whole is thus thoroughly mixed; the time-chemical-fuse, broken by the shock of striking, will cause the explosion of the whole mixture at the end of any given desired interval thereafter.

In the latest model of these explosive shells, the glass case containing the nitric acid is cemented to the interior of another case of thin wrought iron; the latter can be introduced within the projectile when desired.

These percussion shells have been fired at long ranges so as to land in ordinary hard ground; the shells exploded on entering the ground; the explosion was so violent that the pieces of the shell flew radially in all directions, backward almost as far as forward, thus showing the intensity of the explosion. Such shells, exploding behind the interior crest of a parapet, would destroy material behind this parapet and would injure men who might consider themselves secure because they were sheltered from direct fire.

This explosive has been tested by blows from a pile driver, in order to see how liable it is to explode under percussion. A weight of 112 kilogrammes (246 pounds) falling one metre, broke the case of the fuse without producing explosion; falling three metres it still failed to produce explosion; but falling four metres it produced explosion.

Two examples may be quoted to show the strength and violence of the explosion. First, a chilled iron cylinder of 30 inches diameter was torn all to pieces by the powder which filled an 0.8-inch hole along its axis. Second, one kilogramme of the explosive was placed in a cast-iron shell of 75 pounds weight, and exploded; the explosion tore the shell all to pieces in such a way that 240 of its fragments weighed in all only 37 pounds; the rest of the fragments were not to be found.

On the 29th November, 1881, the writer witnessed some experiments with this new explosive.

The solid component looked like brown sugar, except that the crystals were needle-like, and nearly an eighth of an inch in length. When these crystals were placed in the flame of a Bunsen burner, they burnt slowly in much the same way as sugar or sealing wax and with a good deal of smoke; some of the crystals were put on an anvil and hammered without explosion; the crystals were then put into strong, but not fuming, nitric acid and were immediately dissolved; a few drops of the solution were put on an anvil and hammered without exploding; a piece of paper dipped in the solution, was put in the flame of the Bunsen burner and burnt in about the same way as the crystals had burnt; a piece of paper put into the solution, so as to serve as a wick, was then lighted and burnt with increased flame but without igniting the solution. Water was then poured into the solution, and the solid component re-crystalized into white, flaky crystals; this re-crystalization was accompanied by a slight *reduction* in temperature, hardly sufficient to be noticeable to the touch. Some of the explosive mixture was then placed in a thin metal tube in the ground outside the building, and exploded by the use of a friction primer of triple the strength ordinarily used for exploding dynamite; the explosion produced a very effective result. The brown crystals were said to be poisonous if eaten; but not poisonous enough to produce any bad effects if simply tasted or handled; an actual test showed the writer that it was slightly astringent with something of the taste of quinine.

Captain Piorkowski, Mr. Gruson's representative, was at Berlin on the 18th November, 1881; on his return, he stated that the Prussian Government were going to continue experiments with the new Gruson explosive at Graudentz. The explosive does not yet work regularly enough as it explodes sometimes one second only and sometimes as much as ten seconds after impact.

Mr. Gruson would like to have some other government, besides Prussia, experiment with this explosive; especially some government which would be willing to publish the results of its tests. He would not be willing, however, to make known the composition of the explosive unless in some way he could be first guaranteed a royalty or other compensation for the use of the powder if it should prove to be what he claims for it. For a similar reason he is not willing to furnish a sample of the crystalline powder, because it might be analysed and the secret of the explosive discovered. He would be willing to send an agent to the United States or any foreign country to exhibit the explosive, in case that there was any possibility of selling the explosive, or obtaining a royalty for its use. He would be willing to sell anybody the use of this powder, and the right to manufacture it, but only in consideration of a cash sum payableimmediately, or a royalty during a term of about 15 years.

He estimates that the strength of this explosive is 1.3 times as powerful as nitro-glycerine, and that the cost would be about 25 cents a pound, or less.

Miner's Powder.—Another explosive, tested in France, has been brought to the writer's notice. This explosive is the invention of M. Michalowski, and is called "miner's powder." It is powerful, easily made, easily and safely handled and transported and is well adapted to many military operations.

This powder was lately investigated by the Society of Mineral Industry at Saint Etienne, France.[2]

"As the result of a series of experiments, the committee reported, in substance as follows:

According to the wording of the patent the composition of the powder is:

Chlorate of potash	50
Bioxide of manganese	5
Organic matter, finely pulverized	45
	100

The organic matter which forms the combustible element of the explosive mass, should be wood sawdust, powdered tan, bran, etc.

The committee concluded their report as follows;

1. That the "miners powder" was manufactured without danger, in the most simple

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[1] This explosive has since been named "Heilhoffite," and its crystalline ingredient has been made known as a variety of binitro-benzene, or of binitro-benzole. See ENG. NEWS, p. 228, Oct. 10, 1885.

[2] See page 90 of ENGINEERING NEWS for 23rd February, 1884.

manner; it was only required to add bran to a solution of chlorate of potash and leave it dry.

2. That its transportation should be attended with no difficulties, for it was only after some effort that particles were exploded upon an anvil.

3. That the force of the powder is practically equal to dynamite No. 1.

4. That the gases produced by its explosion are probably much less injurious than those emanating from other explosives.

5. That this powder can be firmly compressed by rammers without danger, provided no sparks are evolved."

Ammonia-nitrate powder.—Still a third of these safe but violent explosives, available for many military operations, has been brought to the writer's notice. In this explosive, ammonia-nitrate forms the principal ingredient.

This explosive was not tested in the writer's presence but was said to be as powerful as dynamite, to fuse but not burn in the presence of a flame, and to be exploded with difficulty under the blow of a hammer.

This powder is said to be composed of

Nitrate of ammonia	80
Chlorate of potash	5
Nitro-glucose	10
Coal tar	5
	100

The explosion of this powder requires the use of a 10-grain fulminating cap.

Accuracy of Fire of Modern Ordnance.

Field Guns.—When fired at ranges of between 300 and 3,000 yards, the 9-pounder (about 5-inch) R. M.-L. gun allows an average difference of range equal to 0.01 times the average range, and an average lateral deviation equal to 0.001 times the average range. These deviations are a little greater for the 16-pounder (6-inch) R. M.-L. gun under similar circumstances [3].

With a 9-inch 12-ton gun, 20 rounds at 1,000 yards; extreme error of elevation 13.5 feet, mean 4.7 inches; extreme error in direction 9.75 feet, mean 4.4 feet [4].

Heavy Guns.—In firing for prizes at Shoeburyness, with 10-inch gun, at targets 9 feet by 9 feet; ranges 1,200 and 1,600 yards, strong and variable wind across the range; out of 35 rounds there were 7 hits, 6 ricochets; maximum error in range, 110 yards; minimum, 6.5; mean, 30. With a 12-inch gun at 1,000 yards, the mean error in range was 16 yards, mean error in direction 4 yards; at 2,000 yards, 10 and 0.5; at 3,000 yards, 10 and 0.8; at 4,000 yards, 17 and 1.9; at 5,000 yards, 31 and 2.5 [4].

Firing at a rock at Vigo 600 feet long and 60 feet high at 1,000 yards (with a quiet sea) the S. S. Hercules fired 17 times, hit 10; S. S. Captain fired 11 times, hit 4; S. S. Monarch fired 12 times, hit 9 [4].

The Krupp 11-inch 35-caliber-length guns, 12-inch 35-caliber-length guns, and the 14-inch 30-calibers-length guns, have all been fired at 4.5 miles range, and have placed 50 per cent. of their hits within a horizontal rectangle 17 feet wide and 125 feet long in range; the flight of the shot requiring about 20 seconds [5].

The 17.7-inch 100-ton gun, fired at from 3 to 4 miles range, will place nearly all of its shot within a vertical target 80 feet high and 30 feet wide, or, (as the shot has them a descending trajectory of about 22 degrees with the horizontal) within a horizontal target, 30 feet wide and 220 feet long [6].

Rifled Mortars or Howitzers.—The Prussian and Austrian 21-c.m. (8.3-inch) rifled mortars can be advantageously used against a target 82 yards long and 16 yards wide, up to 3,000 yards range; and have been known to place 25 per cent. of their hits within a target 98 feet long and 13 feet wide at 3,000 yards range, and also within a target 139 feet long and 11 feet wide at 4,900 yards range. These rifled shot at this range will injure arches of 40 inches masonry covered by 98 inches earth[7].

TO BE CONTINUED.

[3] See page 172, Vol. 1, R. E. Aide Memoire, 1876.
[4] See page 184, Vol. 1, R. E. Aide Memoire, 1876.
[5] See U. S. Ord. Notes, No. 244.
[6] See also page 45, U. S. Engrs. Prof. Papers, No. 25.
[7] See U. S. Ord. Notes, No. 244.

Underground Temperatures.

The committee appointed for the purpose of investigating the rate of increase of underground temperature downwards in various localities of dry land and under water have recently issued their seventeenth report (for the two years since the summer of 1883), which has been drawn up by Professor Everett, the secretary of the committee.

The report opens with an account of some observations made in the deep bore-hole of the water-works at Richmond (Surrey), by Mr. Collett Homersham, C. E., under whose supervision the boring operations have been conducted for the Select Vestry. The bore-hole is on the right bank of the Thames, and about 33 yards from high-water mark. The surface is 17 feet above Ordnance datum. The upper part consists of a well 253 feet deep (having an internal diameter of 7 feet at top and 5 feet at bottom) which was sunk in 1876 for the purpose of supplying the town with water, and was carried down to the chalk. From the bottom of the well a 24-inch bore-hole was sunk to the total depth of 434 feet; thus penetrating 181 feet into the chalk. This portion of the work was completed in 1877. Above the chalk were tertiaries, consisting of 160 feet of London clay, 60 feet of the Woolwich and Reading beds, and some underlying sands. The water yielded at this stage was about 160 gallons per minute; and, when not depressed by pumping, was able to rise three or four feet above the surface. Its ordinary level, owing to pumping, was about 130 feet lower.

In 1881 the Richmond Vestry determined to carry the bore-hole to a much greater depth, and the deepening has been executed under the direction of Mr. Homersham. The existing bore-hole was first enlarged and straightened, to enable a line of cast-iron pipes, with an internal diameter of 16½ inches, having the lower end driven water-tight into the chalk at a depth of 438 feet, to be carried up to the surface. The total thickness of the chalk was 671 feet. Below this was the upper greensand, 16 feet thick; then the gault clay, 201½ feet thick, then 10 feet of a sandy rock, and a thin layer of phosphatic nodules. Down to this point the new boring had not yielded any water. Then followed a bed 87½ feet thick, consisting mainly of hard oolitic limestone. Two small springs of water were met with in this bed, at the depths of 1203 and 1210 feet; the yield at the surface being 1½ gallons a minute, with power to rise in a tube and overflow 49 feet above the ground. A partial analysis of this limestone rock showed it to contain 2.4 per cent. of sulphide of iron in the form of pyrites. At the depth of 1239 feet this limestone rock ended, and hard red sandstone was found, alternating with beds of variegated sandy marl or clay. After the depth of 1253 feet had been attained the yield of water steadily increased as the boring was deepened; the overflow at the surface being two gallons a minute at 1254 feet, eight gallons at 1363 feet, and eleven gallons at 1387 feet. It rose to the top of a tube carried 49 feet above the surface, and overflowed; and a pressure-gauge showed that it had power to rise 126 feet above the surface. The diameter of the bore was 16½ inches in the chalk, 13½ inches in the gault, 11¼ inches in the oolitic limestone, and at the depth of 1334 feet it was reduced to a little less than 9 inches.

At 1337 feet the method of boring was changed; and, instead of an annular arrangement of steel cutters, a rotary diamond rock-boring machine was employed. The bore-hole, with a diameter of 8½ inches, was thus carried down to 1367½ feet, at which depth, lining-tubes having to be inserted, the diameter was reduced to 7¼ inches; and this size was continued to 1447 feet, at which depth the boring was stopped. The bore-hole was lined with strong iron tubes down to the depth of 1364 feet; and those portions of the tubes that are in proximity to the depths where water was struck were drilled with holes to admit the water into them.

Three observations of temperature, taken with an inverted Negretti maximum at the depth of 1337 feet, when the bore-hole was full of water, recorded 75½° Fahrenheit. In the first observation (on March 25, 1884) the thermometer was left for 1½ hours at the bottom of the bore-hole, and three weeks had elapsed since the water was disturbed by boring. The second observation was taken on March 31, when the thermometer was 5½ hours at the bottom. In the third observation special precautions were taken to prevent convection. The thermometer was fixed inside a wrought-iron tube, 5 feet long, open at the bottom. The thermometer was near the lower end of the tube, and was suspended from a water-tight wooden plug, tightly driven into the tube. There was a space of several inches between the plug and the thermometer, and this part of the tube was pierced with numerous holes, to allow the escape of any cold water which might be carried down by the tube.

The tube was one of a series of hollow boring-rods used in working the diamond-drill machine. By means of these it was lowered very slowly, to avoid disturbance of the water as much as possible; and the tube containing the thermometer was gradually worked through the sand at the bottom of the bore-hole. The lowering occupied five hours, and was completed at noon on Saturday, June 7. Cement, mixed with sugar, for the purpose of slow setting, was immediately lowered on the the surface of the sand, and above this a mixture of cement and sand, making a total thickness of 3 or 4 feet of cement plugging. The thermometer was left in its place for three full days, the operation of raising being commenced at noon of Tuesday, June 10, and completed at 5 P. M. The thermometer again registered 75½° Fahr.—exactly the same as in the two previous observations, which were taken without plugging. It would therefore appear that the steady up-flow of water in the lower part of the bore prevents any downward convection of colder water from above.

The boring has since been carried to the depth of 1,447 feet, with a diameter reduced to 7¼ inches, and Mr. Homersham lowered the thermometer to the bottom without plugging. It remained down for six days (February 3 to 9, 1885), and gave a reading of 76¾° Fahr. The water overflowing at the surface had a temperature of 59° Fahr. To deduce the mean rate of increase downwards, a surface temperature of 50° Fahr. is assumed. This gives for the first 1,337 feet an increase of 25½°, which is at the rate of 1° Fahr. in 52.4 feet, and for the whole 1,447 feet, an increase of 26¾°, which is at the rate of 1° Fahr. in 54.1 feet. These results agree with the Kentish Town well, where Mr. Symons found in 1,100 feet an average increase of 1° in 55 feet.

Mr. Galloway has furnished observations taken during the sinking of a shaft to the depth of 1,272 feet in or near the Aberdare Valley, Glamorganshire. The position of the shaft is on the slope on the east side of the valley, about midway between the bottom of the valley and the summit of the hill which separates it from the Merthyr Valley. The mouth of the shaft is about 800 feet above sea level.

Observations were taken at four different depths—546 feet, 780 feet, 1,020 feet and 1,272

feet, the thermometer being in each case inserted, and left for 24 hours in a hole bored to the depth of 30 inches at a distance not exceeding 2½ yards from the bottom of the shaft for the time being. About eight hours elapsed between the completion of the hole and the insertion of the thermometer. The strata consist mainly of shales and sandstone, with a dip of 1 in 12, and the flow of water into the shaft was about 250 gallons per hour.

The first of the four observations was taken in the fire-clay under the Abergorkie vein; the second in strong "clift" (a local name for argillaceous shale) in disturbed ground; the third in bastard fire-clay under a small rider of coal previously unknown; the fourth in "clift" ground 2 yards above the red-ash vein, which overlies the 9 feet seam at a height of from 9 to 12 yards.

The observations were as follows:—At 546 feet, 56 degrees Fahr.; 780 feet, 59½ degrees Fahr.; 1,020 feet, 63 degrees Fahr.; 1,272 feet, 66½ degrees Fahr. Comparing consecutive depths from 546 feet downwards, we have the following increments of temperature:—3½ degrees in 234 feet, giving 1 degree for 69 feet; 3½ degrees in 252 feet, giving 1 degree for 72 feet. They show a remarkably regular rate of increase. A comparison of the first and fourth observations gives an increase of 10½ degrees in 726 feet, which is at the rate of 1 Fahr. in 69.1 feet. As a check upon this result, the Committee find that this rate of decrease reckoned upwards from the smallest depth (546 feet) would give a service temperature of (56.0—7.9=) 48.1 degrees, which, as the elevation is 8000 feet, is probably very near the truth.

Mr. Garside has sent an observation of temperature taken by himself in the roof of the Mersey Tunnel in August, 1883. The temperature was 53 degrees, the depth below Ordnance datum being 92 feet. A great quantity of water from the river was percolating through the sides of the tunnel. On August 13, 1854, he verified his previous observation in Denten Colliery (given in the Commitee's fifteenth report).

The second observation was made at the same depth as the first (1,317 feet), in the same pit and level, and under the same circumstances, except that the thermometer was allowed to remain fourteen days, instead of only six hours in the hole, bored for it. The temperature observed was the same as before—viz., 66 degrees. Mr. Garside has also supplemented his previous contribution to our knowledge of the surface temperature of the ground in East Manchester coal-field by two more years' results from the same observing stations. The difference between them agrees well with the generally accepted rate of one degree for 300 feet, and indicates about 48 degrees as the surface temperature at small elevations, such as 30 feet. The pits in the East Manchester coal fields, from which we have observations—viz., Astley Pit (Dukinfield), Ashton Moss, Bredbury, Denton and Nook Pit, are all sunk in ground at elevations of between 300 and 350 feet. It would therefore appear that the assumption of a surface temperature of 49 degrees, which we made in reducing these observations, is about 2 degrees in excess of the truth. A very elaborate paper on "Underground Temperatures" has recently been communicated to the Royal Society by Professor Prestwich. He is disposed to adopt 1 degree Fahr. in 45 feet as the most probable value of the normal gradient.—London *Mechanical World*.

An Ancient Aqueduct.—A tunnel, measuring about 5,000 feet long and constructed at least nine centuries before the Christian era, has just been discovered by the Governor of the Island of Samos. Herodotus mentions this tunnel, which served for providing the old seaport with drinking water. It is completely preserved and contains water tubes of about 10 inches in diameter, each one provided with a lateral aperture for cleansing purposes. The tunnel is not quite straight.

Advertising and its Relation to Commerce.

An interesting lecture on Advertising and its Relations to Commerce was recently delivered by Mr. Henry Sell, at a meeting of the Balloon Society in London, England. The lecturer said that advertising had its origin in the need of human beings finding means of communicating their wants and the business they had on hand to those near and remote. He spoke of circus notices in old Rome, and of the written bills which were found on the walls of Pompeii when it was disinterred, and then went on to speak of the great change which the invention of printing made in everything in which man was engaged. He traced the history of newspapers, and showed that in the earliest of them advertisements had place, and spoke of the probability of the earliest English advertisements, as we now know advertisements having appeared in the years of Cromwell's Protectorate; one generally supposed to be the first relating to a panegyrical poem on Cromwell's return from Ireland. After further referring to the history of the press and the stamp duty on newspapers, the lecturer said there was at the same time a tax on advertisements, each separate advertisement having to bear a tax of 3s. 6d. It was difficult to make out how, with these imposts, papers could live at all.

It was evident that they must be dear, and the purchase of them very limited. The need for cheaper papers and the increased interest in public affairs led to a movement which resulted in the abolition of the taxes on knowledge, as they were called. The penny paper was the immediate consequence; and, to note one instance, the circulation of the *Daily News* jumped up from about 50,000 to upwards of 150,000 within a week. The lecturer exhibited by figures the effect which the increased circulation had on advertisers, and, of course, on the value of newspapers. He showed that in a day in 1832 the *Times* contained only 121 advertisements; that one day in 1844 the number was 1,400; in 1855 it had risen to 2,122; and that ten years after it had again risen to 2,502. He pointed out that one of the London morning papers, the advertisements appearing in which he had counted, and which numbered 2,179, would, if the old advertisement tax existed, have had to pay no less a sum than £380 a day. The lecturer proceeded to speak of the enormous revenues which newspapers now receive from advertisements, and said that to that we owed the fact that the proprietors were able to secure and reward adequately the services of so many special correspondents and able writers of all classes. He showed how vast an influence this business had on commerce; and how, as a means of getting business, advertisers addressed people in all, even the most remote, parts of the world.—*Bradstreets*.

Strength of Granite.

While tests have been made to ascertain the resistance of granite to pressure, too much dependence must not be placed on results given in text-books. Granite, like other material of which I have had experience, has a cleavage the same as sandstones have, although this is not the popular opinion, and would be condemned by the orthodox geologist, as it touches on the theory as asserted of granite being an igneous and not an aqueous rock. I mention this not for the purpose of geological dispute, but to reiterate what I have before asserted as to sandstone, namely, that to use granite so as to get the greatest resistance to pressure, the stone should be used so that the force should be at right angles to the cleavage or bedway of the materials. That brings me to this, that granite, like sandstone, laid upon its natural bed, will increase in strength in the ratio of its superficies. However, I repeat as to crushing that, if granite is fairly bedded on an equal and resisting foundation, no load can in ordinary circumstances crush it. It may be safe enough, in dealing with granite, to take from 684 to 848 tons per square foot as a fair test of its stength.—*James Gowans*.

OUR MATHEMATICAL COLUMN.

THE METHOD of EQUIPOLLENCES, founded by Bellavitis, is a particular case of the theory of quaternions, which furnishes a remarkable and elegant method of dealing with plane problems. A recent exposition of its principles has been published by Dr. S. M. Barton, of the University of Virginia.

THE ELEMENTS OF GEOMETRY, by George Bruce Halsted, is an octavo volume of 366 pages, recently published by John Wiley & Sons. Here will be found given the most modern methods of treating this fundamental mathematical subject. At first sight it may seem to those who have been trained in the geometry of Euclid, that the introduction of new terms and generalized methods would tend to confuse, rather than to make clear the reasoning and results. But a careful consideration will show that the introduction of these tends to broaden the field of investigation and render the science more fruitful. For instance, the word "sect" is used to indicate a limited straight line, such as the side of a triangle, while the word "line" is reserved to denote an unlimited or indefinite straight line. The term "perigon" indicates four right angles, and "straight angle" denotes two right angles. An angle greater than a straight angle and less than a perigon is called a "reflex angle." A most excellent and advantageous term is that of "explement," which denotes the difference between a given angle and a perigon. The word "congruent" is applied to magnitudes which are identical in every respect except as to the place in space where they may be.

As would be expected the demonstrations are very brief compared with those of Euclid, and by the use of signs for such common words as similar, parallel, triangle, angle, etc., the brevity is often very striking. Different kinds of type are used in stating the hypothesis, the proof and the conclusions of a theorem, and the figures are drawn in such a manner as to be of great assistance to students.

The method of treatment of the subject of parallel lines starts from the definition that parallel lines are such as are in the same plane, and which, being produced ever so far both ways, do not meet. This subject, together with triangles, polygons and other primary relations, occupies Book I. In Book II rectangles are treated, in Book III the circle, and in Book IV regular polygons. Book V is devoted to the difficult subject of ratio and proportion, where Euclid's definition of proportionality furnishes the basis of the method. Book VI treats of planes and lines, Books VII and VIII to spherics, Book X to polyhedrons, and lastly Book XI to mensuration. The work is an original and masterly one throughout.

PROBLEM 17. Let A and B be two points whose elevations above a given bench mark M are to be determined, the distances MA, MB and AB being nearly equal. A line of levels is run from M to A which shows that A is 12 inches higher than M. A line is also run from M to B showing that B is 16 inches higher than M, lastly a line is run from B to A which shows that B is 5 inches higher than A. It is required to find the most probable elevations of A and B above the bench mark M.

Let a be the elevation of A and b that of B. Then the observations furnish the following equations:—

$$a = 12 \text{ inches}$$
$$b = 16 \text{ inches}$$
$$b - a = 5 \text{ inches}$$

To find the most probable values of a and b, these three equations must be reduced to two by means of the method of Least Squares; thus,

$$2a - b = 7$$
$$-a + 2b = 21$$

By solving these two normal equations we find the values

$$a = 11\frac{2}{3} \text{ inches}$$
$$b = 16\frac{1}{3} \text{ inches},$$

and these are the most probable elevations of A and B above the bench mark M.

Result of Interesting Experiments.—Tests made of the elevated railroad structures, of the Brooklyn Bridge cables, and iron store fronts, show that they are all magnetized. The induced magnetism from the earth is supposed to have been fixed by the jarring to which these structures have been subjected while under magnetic influence. The bottom parts of all pieces of iron thus magnetized show north polarity, and the cables of the bridge are said to be magnetized in the direction of their diameter, the upper surface of the cables, throughout their length, being of south polarity and lower surface north.

Report of the Committee on a Uniform System for Tests of Cement.*

Presented at the Annual Meeting, January 21, 1885.

To the American Society of Civil Engineers:

Your Committee, appointed to devise a uniform system for tests of hydraulic cement, has the honor to submit this final report. Those portions of the preliminary report presented at the Annual Meeting held January 16th, 1884, which are not embodied herein, are superseded.

A uniform system of testing cement, in order to be practical, must be simple, rapid, and easy of application, and should, of course, be reasonably accurate. Between the very careful tests of the laboratory, which consume much time and involve considerable expense, and the rough and unsatisfactory trials often resorted to from necessity, there is a middle ground, which it has been the endeavor of the Committee to occupy. The system proposed is by no means a perfect one—such has not yet been discovered—but it is hoped that it will be useful in eliminating many of the inaccuracies of the usual methods, and by making the system uniform, enable the experiments of the various members of the profession, in different parts of the country, and others interested in the subject of cement testing, to be satisfactorily compared.

TESTS OF CEMENT.

The testing of cement is not so simple a process as it is sometimes thought to be. No small degree of experience is necessary before one can manipulate the materials so as to obtain even approximately accurate results.

The first tests of inexperienced, though intelligent and careful persons, are usually very contradictory and inaccurate, and no amount of experience can eliminate the variations introduced by the personal equations of the most conscientious observers. Many things, apparently of minor importance, exert such a marked influence upon the results, that it is only by the greatest care in every particular, aided by experience and intelligence, that trustworthy tests can be made.

The test for tensile strength on a sectional area of one square inch is recommended, because, all things considered, it seems best for general use. In the small briquette there is less danger of air bubbles, the amount of material to be handled is smaller, and the machine for breaking may be lighter and less costly.

The tensile test, if properly made, is a good, though not a perfect indication of the value of a cement. The time requisite for making this test, whether applied to either the natural† or the Portland cements, is considerable (at least seven days, if a reasonably reliable indication is to be obtained) and as work is usually carried on, is frequently impracticable. For this reason, short time tests are allowable in cases of necessity, though the most that can be done in such testing, is to determine if the brand of cement is of its average quality. It is believed, however, that if a neat cement stands the one day tensile test, and the tests for checking and for fineness, its safety for use will be sufficiently indicated in the case of a brand of good reputation; for, it being proved to be of average quality, it is fair to suppose that its subsequent condition will be what former experiments, to which it owes its reputation, indicate that it should be. It cannot be said that a new and untried cement will by the same tests be proved to be satisfactory; only a series of tests for a considerable period, and with a full dose of sand, will show the full value of any cement; and it would be safer to use a trustworthy brand without applying any tests whatever, than to accept a new article which had been tested only as neat cement and for but one day.

The test for compressive strength is a very valuable one, in point of fact, but the appliances for crushing are usually somewhat cumbersome and expensive, so much so that it seems undesirable that both tests should be embodied in a uniform method proposed for general adoption. Where great interests are at stake, however, and large contracts for cement depend on the decision of an engineer as to quality, both tests should be used if the requisite appliances for making them are within reach. After the tensile strength has been obtained the ends of the broken briquettes, reduced to one-inch cubes by grinding and rubbing, should be used to obtain the compressive strength.

The adhesive test being in a large measure variable and uncertain, and therefore untrustworthy, is not recommended.

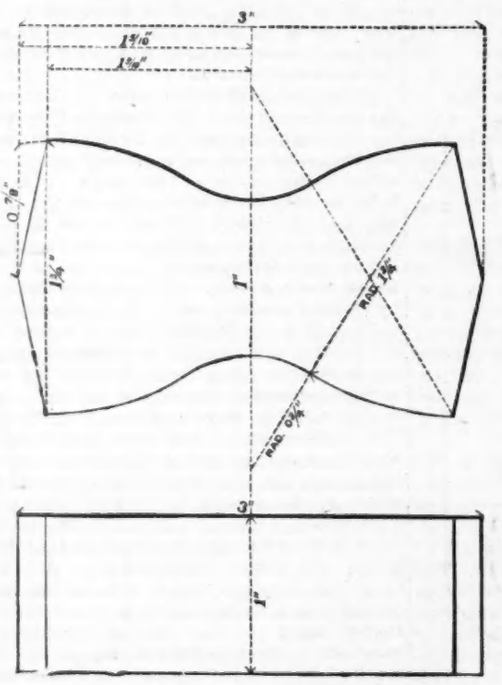
FINENESS.

The strength of a cement depends greatly upon the fineness to which it is ground, especially when mixed with a large dose of sand. It is, therefore, recommended that the tests be made with cement that has passed through a No. 100 sieve (10,000 meshes to the squar einch), made of No. 40 wire, Stubbs' wire gauge. The results thus obtained will indicate the grade which the cement can attain, under the condition that it is finely ground, but it does not show whether or not a given cement offered for sale shall be accepted and used. The determination of this question requires that the tests should also be applied to the cement as found in the market. Its quality may be so high that it will stand the tests even if very coarse and granular, and, on the other hand, it may be so low that no amount of pulverization can redeem it. In other words, fineness is no sure indication of the value of a cement, although all cements are improved by fine grinding. Cement of the better grades is now usually ground so fine that only from 5 to 10 per cent. is rejected by a sieve of 2,500 meshes per square inch, and it has been made so fine that only from 3 to 10 per cent. is rejected by a sieve of 32,000 meshes per square inch. The finer the cement, if otherwise good, the larger dose of sand it will take, and the greater its value.

CHECKING OR CRACKING.

The test for checking or cracking is an important one, and though simple should never be omitted. It is as follows:

Make two cakes of neat cement 2 or 3 inches in diameter, about ½ inch thick, with thin edges. Note the time in minutes that these cakes, when mixed with water to the consistency of a stiff plastic mortar, take to set hard enough to stand the wire test recommended by Gen. Gillmore, $\frac{1}{12}$-inch diameter wire loaded with ¼ of a pound, and $\frac{1}{24}$-inch loaded with 1 pound. One of these cakes, when hard enough, should be put in water and examined from day to day to see if it becomes contorted, or if cracks show themselves at the edges, such contortions or cracks indicating that the cement is unfit for use at that time. In some cases the tendency to crack, if caused by the presence of too much unslacked lime, will disappear with age. The remaining cake should be kept in the air and its color observed, which for a good cement should be uniform; the Portland cements being of a bluish gray throughout, yellowish blotches indicating a poor quality; and the natural cements being light or dark, according to the character of the rock of which they are made. The color of the cements when left in the air indicates the quality much better than when they are put in water.



DETAILS FOR BRIQUETTE,
AS RECOMMENDED BY THE COMMITTEE
ON A UNIFORM SYSTEM FOR
TESTS OF CEMENT.
PLATE XLIV.

TESTS RECOMMENDED.

It is recommended that tests for hydraulic cement be confined to methods for determining fineness, liability to checking or cracking, and tensile strength; and for the latter, for tests of seven days and upward, that a mixture of one part of cement to one part of sand for natural cements, and three parts of sand for Portland cements, be used, in addition to trials of the neat cement. The quantities used in the mixture should be determined by weight.

The tests should be applied to the cements as offered for sale. If satisfactory results are obtained with a full dose of sand the trials need go no further. If not, the coarser particles should first be excluded by using a No. 100 sieve, in order to determine approximately the grade the cement would take if ground fine, for fineness is always attainable, while inherent merit may not be.

Note. Your committee thinks it useful to insert here a table showing the average minimum and maximum tensile strength per square inch which some good cements have attained when tested under the conditions specified elsewhere in this report. Within the limits given in the following table, the value of a cement varies closely with the tensile strength when tested with the full dose of sand:

American natural cement, neat:

One day; one hour or until set in air, the rest of the twenty-four hours in water, from forty pounds to eighty pounds.

One week; one day in air, six days in water, from sixty pounds to 100 pounds.

One month (twenty-eight days): one day in air twenty-seven days in water, from 100 pounds to 150 pounds.

One year; one day in air, the remainder in water, from 300 pounds to 400 pounds.

American and foreign Portland cements, neat:

One day; one hour, or until set, in air, the rest of the twenty-four hours in water, from 100 pounds to 140 pounds.

One week; one day in air, six days in water, from 250 pounds to 550 pounds.

One month (twenty-eight days); one day in air, twenty-seven days in water, from 350 pounds to 700 pounds.

One year; one day in air, the remainder in water, from 450 pounds to 800 pounds.

American natural cement, one part of cement to one part of sand:

One week; one day in air, six days in water, from thirty to fifty pounds.

One month (twenty-eight days); one day in air, twenty-seven days in water, from fifty pounds to eighty pounds.

One year; one day in air, the remainder in water from 200 pounds to 300 pounds.

American and foreign Portland cements, one part of cement to three parts of sand:

One week; one day in air, six days in water, from eighty pounds to 125 pounds.

One month (twenty-eight) days); one day in air, twenty-seven days in water, from 100 pounds to 200 pounds.

One year; one day in air, the remainder in water, from 200 pounds to 350 pounds.

Standard of minimum fineness and tensile strength for Portland cement, as given below, have been adopted in some foreign countries.

In Germany, by Berlin Society of Architects, Society of Manufacturers of Bricks Lime and Cement, Society of Contractors and Society of German Cement Makers.

Standard of 1877.—Fineness, not more than 25 per cent. to be left on sieve of 5,806 meshes per square inch.

Tensile strength, one part cement, three parts sand, one day in air, twenty-seven days in water, 113.78 pounds per square inch.

Standard of 1878.—Fineness, not more than 20 per cent. to be left on sieve, as above.

Tensile strength, same mixture and time as above, 142.23 pounds per square inch.

In Austria, by Austrian Association of Engineers and Architects.

Standard of 1878.—Fineness, same as German of 1878.

Tensile strength, same mixture as above, seven days, one day in air, six days in water, 113.78 pounds per square inch.

Twenty-eight days, one day in air, twenty-seven days in water, 170.68 pounds per square inch.

In Austria a standard for the minimum fineness and tensile strength of Roman cement was established and generally accepted, as follows:

Standard of 1878. Fineness, same as Portland.

Tensile strength, (one part of cement, three parts of sand) for:

Quick setting cement (taking fifteen minutes or less to set):

Seven days, one day in air, six days in water, twenty-three pounds per square inch.

Twenty-eight days, one day in air, twenty-seven days in water, 56.9 pounds per square inch.

Slow setting cement (taking more than fifteen minutes to set):

Seven days, one day in air, six days in water, 42.6 pounds per square inch.

Twenty-eight days, one day in air, twenty-seven days in water, 85.3 pounds per square inch.

The Roman cements correspond to those classified in this report under the head of natural cements.

Standards have been adopted also Sweden and Russia.

*From the Transactions of the American Society of Civil Engineers November, 1885.

†Where the word "natural" is used in this connection, it is to be understood as being applied to the lightly burned natural American or foreign cements in contradistinction to the more heavily burned Portland cement, either natural or artificial.

MIXING, ETC.

The proportions of cement, sand and water should be carefully determined by weight, the sand and cement mixed dry, and all the water added at once. The mixing must be rapid and thorough, and the mortar, which should be stiff and plastic, should be firmly pressed into the moulds with the trowel, without ramming, and struck off level; the moulds in each instance, while being charged and manipulated, to be laid directly on glass, slate or some other non-absorbent material. The moulding must be completed before incipient setting begins. As soon as the briquettes are hard enough to bear it, they should be taken from the moulds and be kept covered with a damp cloth until they are immersed. For the sake of uniformity, the briquettes, both of neat cement and those containing sand, should be immersed in water at the end of twenty-four hours, except in the case of one-day tests.

Ordinary, fresh, clean water, having a temperature between sixty and seventy degrees Fahrenheit, should be used for the water of mixture and immersion of samples.

The proportion of water required varies with the fineness, age, or other conditions of the cement, and the temperature of the air, but is approximately as follows:

For briquettes of neat cement, Portland, about 25 per cent.; natural, about 30 per cent.

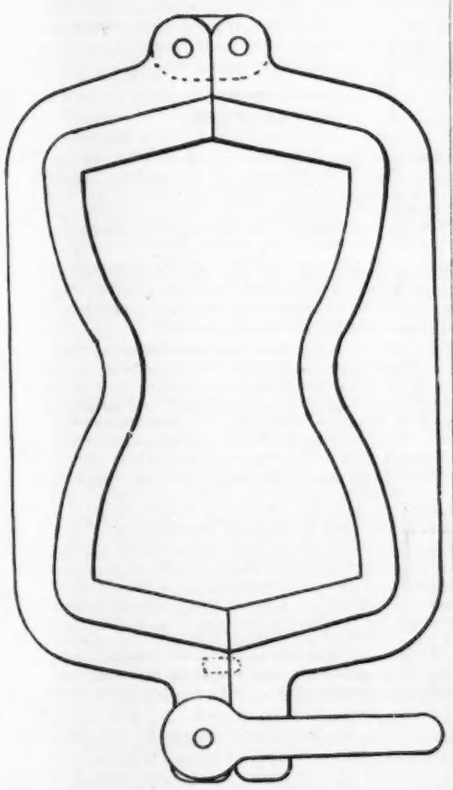


PLATE XLV. STANDARD FORM FOR MOULD

For briquettes of one part cement, one part sand, about 15 per cent. of total weight of sand and cement.

For briquettes of one part cement, three parts sand, about 12 per cent. of total weight of sand and cement.

The object is to produce the plasticity of rather stiff plasterer's mortar.

An average of five briquettes may be made for each test, only those breaking at the smallest section to be taken. The briquettes should always be put in the testing machine and broken immediately after being taken out of the water, and the temperature of the briquettes and of the testing room should be constant between sixty and seventy degrees Fahrenheit.

The stress should be applied to each briquette at a uniform rate of about 400 pounds per minute, starting each time at 0. With a weak mixture one-half the speed is recommended.

WEIGHT.

The relation of the weight of cement to its tensile strength is an uncertain one. In practical work, if used alone, it is of little value as a test, while in connection with the other tests recommended it is unnecessary, except when the relative bulk of equal weights of cement is desired.

We recommend that the cubic foot be substituted for the bushel as the standard unit, whenever it is thought best to use this test.

SETTING.

The rapidity with which a cement sets or loses its plasticity, furnishes no indication of its ultimate strength. It simply shows its initial hydraulic activity.

For purposes of nomenclature, the various cements may be divided arbitrarily into two classes, namely; quick-setting, or those that set in less than one-half an hour; and slow setting, or those requiring one-half an hour or more to set. The cement must be adapted to the work required, as no one cement is equally good for all purposes. In submarine work a quick-setting cement is often imperatively demanded, and no other will answer, while for work above the water-line less hydraulic activity will usually be preferred. Each individual case demands special treatment. The slow-setting natural cements should not become warm while setting, but the quick-setting ones may, to a moderate extent, within the degree producing cracks. Cracks in Portland cement indicate too much carbonate of lime, and in the Vicat cements too much lime in the original mixture.

SAMPLING.

There is no uniformity of practice among engineers as to the sampling of the cement to be tested, some testing every tenth barrel, others every fifth, and others still every barrel delivered. Usually, where cement has a good reputation, and is used in large masses, such as concrete in heavy foundations, or in the backing or hearting of thick walls, the testing of every fifth barrel seems to be sufficient; but in very important work, where the strength of each barrel may in a great measure determine the strength of that portion of the work where it is used, or in the thin walls of sewers, etc., etc., every barrel should be tested, one briquette being made from it.

In selecting cement for experimental purposes, take the samples from the interior of the original packages, at sufficient depth to insure a fair exponent of the quality, and store the same in tightly-closed receptacles impervious to light or dampness until required for manipulation, when each sample of cement should be so thoroughly mixed, by sifting or otherwise, that it shall be uniform in character throughout its mass.

SIEVES.

For ascertaining the fineness of cement, it will be convenient to use three sieves, viz.:

No. 50 (2,500 meshes to the square inch), wire to be of No. 35 Stubb's wire gauge.

No. 74 (5,476 meshes to the square inch), wire to be of No. 37 Stubb's wire gauge.

No. 100 (10,000 meshes to the square inch), wire to be of No. 40 Stubb's wire gauge.

The object is to determine by weight the percentage of each sample that is rejected by these sieves, with a view not only of furnishing the means of comparison between tests made of different cements by different observers, but indicating to the manufacturer the capacity of his cement for improvement in a direction always and easily within his reach. As already suggested in another connection, the tests for tensile strength should be applied to the cement as offered in the market, as well as to that portion of it which passes the No. 100 sieve.

For sand, two sieves are recommended, viz.:

No. 20 (400 meshes to the square inch), wire to be of No. 28 Stubb's wire gauge.

No. 30 (900 meshes to the square inch), wire to be of No. 31 Stubb's wire gauge.

These sieves can be furnished in sets, as follows, an arrangement having been made with a manufacturer* of such articles, by which he agrees to furnish them of the best quality of brass wire cloth, set in metal frames, the cloth to be as true to count as it is possible to make it, and the wire to be of the required gauge. Each set will be enclosed in a box, the sieves being nested.

Set A, three cement sieves, to cost $4.80.

No. 100	7 inches diameter.
No. 74	6 ½ "
No. 50	6 "

Set B, two sand sieves, to cost $4.00:

No. 30	8 inches diameter.
No. 20	7½ "

*Williams' Globe Wire Works, 85 Fulton street, New York City.

STANDARD SAND.

The question of a standard sand seems one of great importance, for it has been found that sands looking alike and sifted through the same sieves give results varying within rather wide limits.

The material that seems likely to give the best results is the crushed quartz used in the manufacture of sand paper. It is a commercial product, made in large quantities and of standard grades, and can be furnished of a fairly uniform quality. It is clean and sharp, and although the present price is somewhat excessive, (3 cents per pound), it is believed that it can be furnished in quantity for about $5.00 per barrel of 300 pounds. As it would be used for tests only, for purposes of comparison with the local sands, and with tests of different cements, not much of it would be required. The price of the German standard sand is about $1.25 per 112 pounds, but the article being washed river sand is probably inferior to crushed quartz. Crushed granite could be furnished at a somewhat less rate than quartz, and crushed trap for about the same as granite, but no satisfactory estimate has been obtained for either of these.

The use of crushed quartz is recommended by your Committee, the degree of fineness to be such that it will all pass a No. 20 sieve and be caught on a No. 30 sieve. Of the regular grade, from 15 to 37 per cent. of crushed quartz No. 3 passes a No. 30 sieve, and none of it passes a No. 50 sieve. As at present furnished, it would need resifting to bring it to the standard size, but if there were sufficient demand to warrant it, it could undoubtedly be furnished of the size of grain required at little, if any, extra expense.

A bed of uniform, clean sand of the proper size of grain has not been found, and it is believed that to wash, dry and sift any of the available sands, would so greatly increase its cost that the product would not be

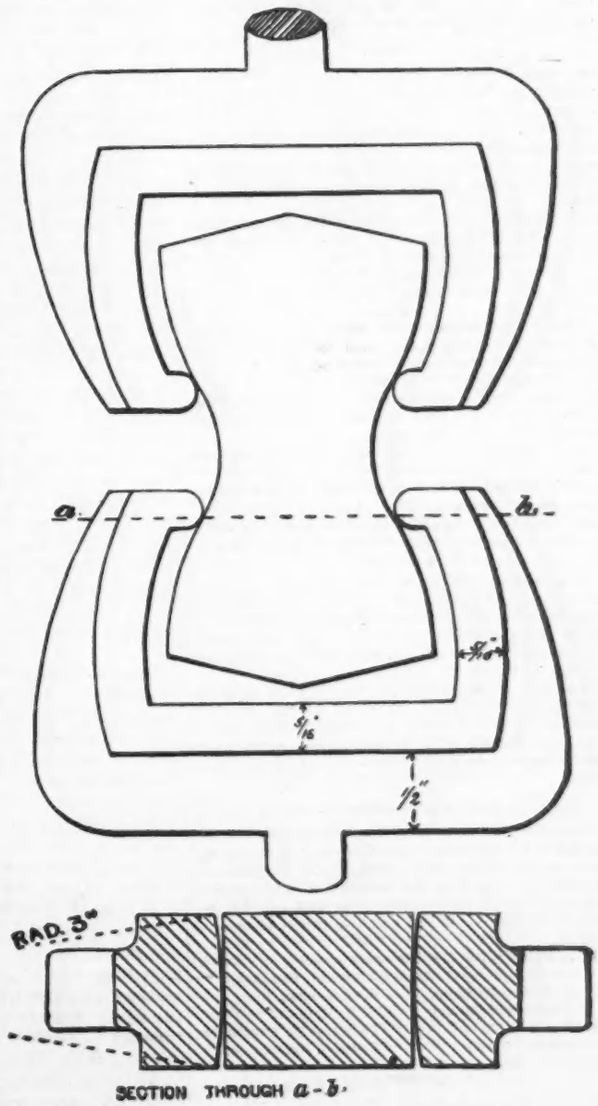


PLATE XLVI. STANDARD FORM FOR BRIQUETTE AND CLIPS.

much cheaper than the crushed quartz, and would be much inferior to it in sharpness and uniform hardness of particles.

MOULDS.

The moulds furnished are usually of iron or brass, the price of the former being $2, and of the latter $3 each. Wooden moulds, if well oiled to prevent their absorbing water, answer a good purpose for temporary use, but speedily become unfit for accurate work. A cheap, durable, accurate and non-corrodible mould is much to be desired, but is not yet upon the market. Plates Nos. XLIV and XLV show the form of briquette and of metal mould recommended. It may be added that your Committee are not in entire accord with respect to the merits of this form of briquette, its principal defect being that the rupture must take place at the neck or smallest section, whether the strain be one of extension only or otherwise. With a briquette of such form that oblique strains would usually produce rupture in oblique directions, the trials taking this character would be rejected, and the accuracy of the results correspondingly increased thereby.

CLIPS.

In using the clips recommended in the preliminary report, it was found in some instances that the specimens were broken at one of the points where they were held. This was undoubtedly caused by the insufficient surface of the clip, which, forming a blunt point, forced out the material. Where the specimens were sufficiently soft to allow this point to be imbedded, they broke at the smallest section, but when hard enough to resist such imbedding, they showed a wedge shaped fracture at the clips. To remedy this, the point should be slightly flattened so as to allow of more metal surface in contact with the briquette. Clips made in this way have been used, and good results obtained.

To adopt the one-inch clips of the Riehle machine, only a slight amount of work is necessary; the ends being rounded as shown in Plate No. XLVI, will admit the proposed new form of briquette, and yet not prevent the use of the old one, thus allowing comparative tests of the two forms to be made without changing the clips.

There should be a strengthening rib upon the outside of the clips, as shown in Plate No. XLVI, to prevent them from bending or breaking when the specimens are very strong.

The clips should be hung on pivots so as to avoid as much as possible cross strain upon the briquettes.

MACHINES.

No special machine has been recommended, as those in common use are of good form for accurate work, if properly used, though in some cases they are needlessly strong and expensive. Machines with spring balances are to be avoided as more liable to error than others.

It is by no means certain that there exists any great difference in well-made machines of the standard forms given.

The experiments of the Committee do not seem to justify an expression of preference for any one machine.

AMOUNT OF MATERIAL.

The amount of material needed for making five briquettes of the standard size recommended is, for the neat cements, about one and two-thirds pounds, and for those with sand, in the proportion of three parts of sand to one of cement, about one and one-quarter pounds of sand and six and two-thirds ounces of cement.

All of which is respectfully submitted.

Q. A. GILLMORE, *Chairman.*

D. J. WHITTEMORE.	F. O. NORTON.
J. HERBERT SHEDD.	W. W. MACLAY.
ELIOT C. CLARKE.	LEONARD F. BECKWITH.
ALFRED NOBLE.	THOS. C. MCCOLLOM.

Inflammability of Timber.

Mr. Braidwood, the able and intelligent superintendent of the London Fire Engine Establishment, stated, in evidence before a Committee of the House of Lords, that by long exposure to heat not much exceeding that of boiling water, timber is brought into such a condition that something like spontaneous combustion takes place; that the time might be eight or ten years—that is to say, it may have taken so long for the heat from the pipes charged with or used to convey steam, hot water or heated air, laid among the joists of a floor, or in the heart of a partition, or elsewhere in a building, encased in timber, to induce the condition necessary to the actual ignition of the timber.—*Prof. Hosking.*

The Chinese Railways.

A writer in the *Iron and Coal Trades Review* of the 4th., says:

The serious depression which has overtaken the iron manufacturing industries has invested the projects of railways in China with a degree of importance they would not possess in more prosperous times. The construction of these projected lines would afford an opportunity sorely needed by those oppressed industries, and hence it has come about that Europeans and Americans are vieing with each other in their efforts to secure to themselves the concessions which the Celestials are to be persuaded into giving to the outer barbarians. The French thought they had stolen a march upon the competitors when they, as one of the conditions of peace, required of the Chinese a promise to purchase all their railway material of their conquerors. A promise given in such circumstances was not likely to be held sacred, and we find in a couple of months the vanquished signatories of the treaty of peace listening to the overtures of other aspirants to favor. It was reported that orders had been placed with English manufacturers, and certain articles which appeared in the *Times* newspaper at the same time gave color to the report. At any rate, the French believed they had been jilted, and began to threaten vengeance both against the jilters and the preferred rival. But ere they had proceeded far in the threatening line, a diversion came to save the English from much abuse. Another report, circumstantially delivered, showed that the favors of the Celestials had been bestowed upon the Americans, and that a powerful syndicate had been formed, with the sanction of the Pekin Government, to carry all the railway projects into effect. Since these disclosures were made English and Americans have watched each other with jealous eyes over this railway question, and the French, seeing their chance gone, have turned their attention to opportunities nearer home.

AN UNNOTICED COMPETITOR.

While the American has been laboring to bear away from his English rival the coveted prize of railway concessions in the Celestial Empire, and the Frenchman has been using the advantage which conquest gives him to deprive both of all share in them, another competitor has been busily at work, unobserved, to frustrate the purpose of all three. The ubiquitous and enterprising German has availed himself of his opportunity to ingratiate himself into favor and to quietly pick up the good things for his own use. For several years past German manufacturers have been watching the development of this railway question with a view of being first in the field. Thanks to their own astuteness in turning to account every favorable circumstance, they have already attained a high measure of success. Hitherto their efforts have not attracted attention because they have gone characteristically to work and accomplished their purpose before noising it abroad. But now that the difficulties attending the preliminary steps have been overcome and the time for action has arrived, they do not hesitate to speak of their achievements and openly to make preparation for the work in which they are seeking to engage themselves. The world will probably learn soon that the people likely to profit most by the Chinese railway schemes are the Germans.

A FAIR FIELD AND A LITTLE FAVOR.

The great firm of Krupp has a representative in all the chief towns of the Chinese empire. It has supplied the Government for some years past with the greater part of its war material; and in this capacity of gun makers its members have been able to win their way into favor with the ruling powers. In this they have been aided by political considerations. China has nothing to fear from Germany. Moreover, the French have made themselves hated by their recent unjustifiable attack, and the Americans have damaged their position by their harsh treatment of Chinese immigrants. Favored by these circumstances, and possessing the opportunities which are open to them through an organized band of agents placed in advantageous positions, Krupp has made himself master of the situation. We now learn thst a strong combination of capitalists and manufacturers is being formed to work the Chinese railway projects, and it is not hard to divine that these are Herr Krupp and his friends. A significant fact is the accession to that firm of an eminent railway engineer well acquainted with China. With these facts before them English manufacturers will perhaps perceive the necessity for more vigorous action on their part. Unless an energetic move be promptly made, they will have to content themselves with the second place. As for the French, they must now regard themselves as completely excluded, notwithstanding the clause inserted in their treaty of peace.

LITERATURE.

Report on Machine-Tools and Wood-Working Machinery. By F. R. HUTTON, M. E., Adjunct-Prof. of Mech. Eng. Columbia College, New York, and Special Agent Tenth Census. Government Printing Office, Washington, D. C., 1885. Large quarto pp. 294.

This document forms a portion of "The Statistics of Power and Machinery used in Manufactures" now being published by the Department of the Interior as a part of the Tenth U. S. Census Report.

Prof. Hutton, in his letter of transmission to Prof. W. P. Trowbridge, the Special Agent in charge, gives an outline of the laborious work here performed, in the course of which he has visited about 60 of the manufacturing centres of the U. S. and gathered the material for his text and the nearly 600 illustrations which accompany them. The work is divided into two parts; one treating of the tools for working metal, the other of wood-working machinery. The tools selected are intended to be type of classes or modifications of a class; but very few unique tools are illustrated.

The result is this investigation shows as the most interesting and important characteristic of American tools and machinery, the general introduction of interchangeable parts; the increasing use of special tools for preparing or shaping materials for special purposes, and the wide use of machinery in building other machines so that they are exact in workmanship and machines adapted to purposes to which they could not be economically applied if built by hand-labor.

Journal of the Association of Engineering Societies. October, 1885.

This is a special number containing index to the last volume, title pages and an index department. This last is a most commendable feature and is under the management of Mr. J. B. Johnson, of the Washington University, of St. Louis, Mo. The present index is a compilation of the index of each number, and embraces much of the current engineering literature of the past year. The intent is to finally bind these annual indices into one volume with the result of having in an easily accessible shape invaluable matter of reference.

THE ANALYSIS OF AN ARTESIAN WELL.—An artesian well was recently bored at Columbus, Miss., and the water therefrom is very cold and possesses rare chemical properties.

A town darkey, with cup in hand, was standing at the well, a day or two ago, when a country darkey jumped off his cotton wagon and asked him to allow him to use his cup to get a drink of the water.

When the country darkey had swallowed the water, he smacked his lips and said:

"I golly, that water's good, show's you bo'n."

Mr. Town Darkey, with an air of great importance, replied:

"In course hit's good; hit's boun' ter be good, fur hit come 4,000 foot from der intrils of der yerth, and hit's bin scandilized by der bes' gymnas from der State Unerversary, and w'at yer think he say hit's got in hit?"

"I dunno," replied the country darkey, smacking his lips, after swallowing another cupful of the water.

"Well, he say dere is ten grains oxhide gas, ten grains cowbonic gas, ten grains foxforus acid and seventy grains hydrophobia in dat water—you know hit's boun' ter be good; dat's a tease yer well, you bet"—and he walked away leaving the country darkey shaking his head and meditating. Finally the latter remarked: "Hit do taste powerful ob der rawhide."

Drainage in Illinois.

Written for ENGINEERING NEWS.

Land drainage on an exceptionally large scale has generally been associated with Holland and Belgium and to a lesser degree with the fens of Lincolnshire in England. In this country it has been understood in a vague sort of a way that in Ohio, Indiana and Illinois, a very large amount of tile and open ditch drainage has been completed within a few years past, and that in part to this condition of things was due the recent flood disasters of these States. The accounts of some very large drainage enterprises in Illinois recently published in the columns of this journal, have been extensively reprinted and a wide-spread interest in the subject has been awakened, both on the part of the general public and the engineering profession. This interest in the subject is so great that we have been at considerable trouble and expense to collect further particulars and with intelligent and trustworthy agents on the ground we expect to be able to place before our readers early and accurate information of these schemes in the States mentioned, which may be projected for the coming year. The money expenditures involved in some of the schemes already under way, give them an importance rivaling that of railroad construction in the same territory.

So far as we have learned, the State of Illinois has the lead in the drainage of agricultural lands in this country, and excepting Holland, in the world. This statement is especially true with reference to tile underdrainage, and also to the excavation of the canals used for outlets for the tile drains. We published an item recently, showing that Illinois has $10,000,000 invested in the tile industry. We will now consider only the larger outlet canals.

This class of work has been very much stimulated by the passage, three years ago, of a new drainage law, which was improved by amendments by the last Legislature.

There are now two laws, practically the same, under which this work may be done. Each provides for the election by interested land owners of three commissioners who have sole charge. The money is raised by special taxation according to the benefit as assessed by a jury appointed for the purpose.

As far as our information goes, the first ditch was constructed near Thomasboro. It is nineteen miles long including branches, and drains, as nearly as we can determine, some 20,000 acres. It was commenced in 1881, and cost $32,000. The work was done piece-meal by inexperienced contractors and is not as good as it might be, but is considered to be worth all it cost. The ditch is from 6 to 16 feet wide, and 4 to 6 feet deep. The price per yard was, 8, 10, and 12 cents. The cost per acre was from 50 cents to $2.50.

Within six or eight miles of this ditch near Rantoul, another about ten miles long and costing $35,000, has just been completed. This ditch and the land which it drains, is owned by one man who has spent $128,000 in draining the tract. A few miles east of this a large contract has just been let, and a few miles west a still larger one is being talked of.

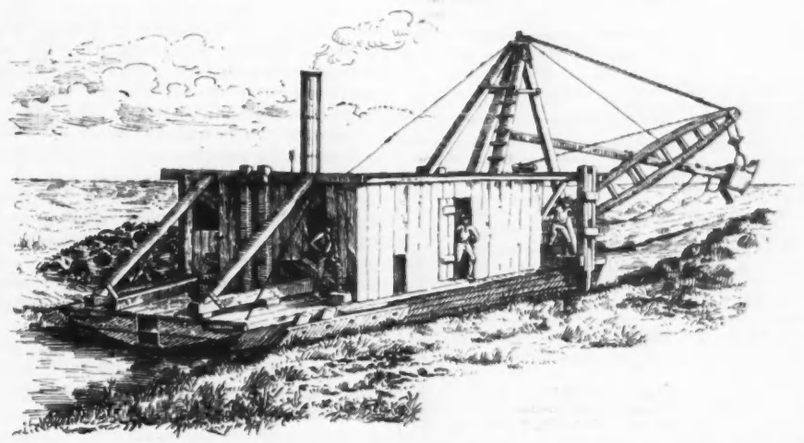
The largest scheme of which we have any information, is the ditch between Pekin and Havana. This was commenced in 1883, and is now nearly completed. The main stem is 14½ miles long, 10 feet deep, and 30 feet wide at the top at beginning, and gradually increasing to 60 feet at top, with side slopes of 1 to 1. There are about 15 or 20 miles of laterals, 8 to 10 feet deep. Total length of ditches 70 miles. The whole drains 47,000 acres, and the cost has been about $250,000.

The county had spent over $400,000 in trying to drain this swamp, previous to commencing this work, and had received but little or no benefit. The ditches were made with spades, and scrapers, and were the best that could be made with those implements, but they were too small and soon filled up. In this kind of work the main channels must be deep to afford an outlet for the tile underdrains.

This was the first work done with a dredge, and has been so satisfactory that it may be said to have worked a revolution in such matters. The dredges, of which five have been used on this work, were constructed for the purpose by the Bucyrus Foundry and Manufacturing Co., Bucyrus, Ohio. They are boom dredges, powerfully built, but drawing less than three feet of water.

The dredges are preferred because they leave the ditch in better shape, and are able to work day and night, in the water and in all kinds of weather, and thus complete the ditch in a reasonable time.

A large scheme is in progress in Piatt county, on which some $50,000 has already been expended, and within a very short time an additional contract has been given for increasing the width of the part already constructed, and for extending the main ditch three miles, which will ultimately be increased to eight or ten miles further. This ditch is being cut by dredges made at Bucyrus, Ohio.



From one of a series of photographs taken on the spot, we have reproduced the accompanying sketch, which shows a Bucyrus dredge at work on an Illinois prairie. The contractors, Messrs. W. A. McGillis & Co., of Manito, Ills., have furnished the following abstract of the work of four of these dredges, for two seasons up to August 1 of this year, the fifth dredge not being purchased until after that time. The prairie drained is 20 miles long, and from three to five miles wide, with branches extending laterally from seven to ten miles.

"Dredge No. 1 lost one and one-half months last season (1884) before she was ready for work, and finished, during the rest of the season, 6½ miles of ditch, 45 feet on top, 25 feet on bottom (and from 8 to 10 feet deep). The same dredge had completed this season, up to August 1st, 3¾ miles of the same sized ditch.

Dredge No. 2 ran all last season, and cut 9½ miles of ditch 30 feet on top, 7 feet on the bottom and 10 feet deep, and has finished 1 mile of the same sized ditch this season, besides cutting 5 miles of ditch, 18 feet on top, 7 feet on the bottom (and from 7 to 10 feet deep).

Dredge No. 3 ran all of last season, making 7½ miles of ditch 30 feet on top, 7 feet on bottom and from 7 to 13 feet deep. She is now working, (August 1st) on the outlet section, and is making about 3,000 feet of ditch per month, 60 feet on top, 40 feet on bottom (and from 9 to 12 feet deep.)

Dredge No. 4 has been in operation only about six weeks, and has made 1¾ miles of ditch, 16 feet on top, 7 on bottom, and 7 to 10 feet deep.

These ditches are constructed through a variable material, muck, loam, sand, clay, quicksand, blue clay and gravel, sometimes separate, and in all sorts of combinations. They are built with a berme of 6 to 10 feet in width, and are entirely finished by the machines; have a good slope on the banks, and regular grade in the bottom, and are entirely free from crumbs or sediment."

The fall is rarely more than three or four feet per mile, and is sometimes as small as one or one and a quarter foot per mile.

The price per yard varies from 13 to 15 cents, which is much cheaper than was bid for scraper work, as much as 19 cents having been paid for the latter.

The manufactures of the Bucyrus Foundry and Manufacturing Co. are so well known among contractors that there is nothing for us to add. These light dredges for farm and highway drainage have been an unsupplied want until met by their enterprise, which must now place them in the lead for this class of machines.

A very large contract is known to be in progress in Vermillion Swamp, Ford county, but of which we have no definite information, except that a dredge is being used.

A six and one half mile ditch is being cut south of Homer, Ill., on the great farm formerly owned by the cattle king, Sullivan; Marion Holloway, of Farmer City, Ill., has a contract for 2½ miles, which he was constructing with scrapers, but has had to suspend for the winter on account of water. This ditch will probably be extended in the near future.

A week or two since we announced the formation of a drainage district at Pesotum, and we have just learned that steps are being taken to form another only a few miles west with head quarters at Bement.

A project is also in progress in the neighborhood of Braidwood to drain the basin which a few years ago poured itself into the coal-mine at that place with so disastrous an effect.

The works described met with great opposition at first, from the land owners, but the results have far exceeded not only their anticipations, but the expectation of the contractors themselves. These ditches actually drain, and drain thoroughly. The contractors deserve great credit for their tenacity and courage, in the face of strong opposition; but they are now reaping the benefit of it. An intelligent man, a capitalist and a farmer, estimates that there are 200 miles of these large drainage canals in progress or contemplation for the immediate future, in Champaign Co., Ill., alone, and that within five years 500 miles will be constructed in that State.

Here then is a comparatively new and promising field of enterprise. We have, as already stated, intelligent and active special agents in Illinois, Indiana and Ohio, gathering the statistics of drainage and other improvements, for this journal, and our readers may rest assured that scarcely an enterprise of any importance will escape our knowledge and speedy publication.

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TABLE OF CONTENTS.

	PAGE
New Ordnance Material	385
Underground Temperature	386
Advertising and its Relation to Commerce	387
Strength of Granite	387
Our Mathematical Column	387
Report of the Committee on a Uniform System for Tests of Cement (*Illustrated*)	388
Inflammability of Timber	390
The Chinese Railways	390
Literature	390
Drainage in Illinois (*Illustrated*)	391
Editorial Notes	392
The Iron Trade and the Future of Engineering	392
English vs. American Rails	392
Annual Report of the Secretary of War	393
Our Coast Defences	393
The Keithburg Bridge	393
Panama Canal	394
The Eruption at Krakatoa	394
Progress of the New Croton Aqueduct	394
Long Freight Trains	394
Shipbuilding on the Clyde	395
Personals	395
American Society of Civil Engineers	395
Engineers Club of Philadelphia	395
Prof. De Smedt's Cement Test	395
English Tramways	395
South Pennsylvania R. R., Cost of Tunneling per Cubic Yard	396
Correspondence	396
News from Many Lands	397
Water	397
News of the Week	399
Recent Patents	400
Market Report	400

CLUBBING ARRANGEMENTS.

1886.

The "subscription season" for the most popular American Magazines is close at hand, and inquiries as to our proposed clubbing arrangements are being made. We beg leave to announce, therefore, that on and after JANUARY 1, 1886, the subscription price of ENGINEERING NEWS will be **$5.00** per year; until that date the price and clubbing rates with other publications will remain as given below.

We are now planning such improvements in ENGINEERING NEWS, and negotiating for special work to be done during the coming year, as will cost double any possible increase of income from subscriptions; the long notice of change which we here give enables nearly, if not all, present subscribers to renew at present rates. We intend eventually to publish a class journal which will acknowledge no superior in the world, and we feel so confident of the support of our present patrons that we have no hesitation in venturing on the greatly increased expense necessary to carry out our programme.

If an English engineering journal, carrying fifty pages of advertisements and twenty four of reading matter sells for $10, why may not an American journal of equal merit sell for at least half as much.

In order to accommodate such of our subscribers as may wish to subscribe for other periodicals, we offer the following terms until January 1, 1886: We will send to any address ENGINEERING NEWS at regular subscription price, **$4.00** and the following at the additional prices given:

	Net. Price.	Reg. Price.
Atlantic Monthly	$3.25	$4.00
Century Magazine	3.55	4.00
Harper's Magazine	3.25	4.00
Harper's Weekly	3.25	4.00
Harper's Bazar	3.25	4.00
Harper's Young People (weekly)	1.65	2.00
Popular Science Monthly	4.25	5.00
St. Nicholas Magazine	2.55	3.00
North American Review	4.10	5.00
Cassell's Magazine of Art	3.00	3.50
Cassell's Family Magazine	1.25	1.50

The Century Magazine commences its year with the November Number; Harper's Magazine commences with the December Number. Subscribers should renew these Magazines in October and November.

TO SUBSCRIBERS.

The date of expiration of subscriptions is given on the printed address-label attached to each copy of this paper, and is, we trust, a sufficient notice to all parties proposing to renew for the ensuing year.

Now that a Congressman, with a corps of miscellaneous assistants, and a special committee on Political Reform of the Union League Club of this city, have appointed themselves consulting engineers to the New Croton Aqueduct, we may expect some startling developments in the science of hydraulic engineering. Where are the "butchers and bakers and candlestickmakers" of Gotham, that they too do not prefer their valuable advice?

The Iron Trade and the Future of Engineering.

Everything seems to point to the revival of our iron interests. According to the *Iron Age*, between November 1st. and December 1st., twenty-one furnaces have been blown in with a weekly additional output of 8,300 tons. At Connelsville, where a short time since but 50 per cent. of the coke furnaces were in operation, 90 per cent. are now at work.

At the Long Branch meeting of the Bessemer rail-makers, an output of 750,000 tons for 1886 was agreed upon: all that, we are told, has been contracted for, and the limit of production has been raised to 1,000,000, and orders, covering at least some mills' quota of the additional 250,000 tons, have been booked.

We give the miles of railroad built, production and price of pig iron, production and price of steel rails, and tons of steel rails imported for the last seven years.

	1878	1879	1880	1881	1882	1883	1884
Miles of R. R. built	2,687	4,721	6,957	9,788	11,596	6,754	3,950
Tons of Pig Iron	2,301,215	2,741,853	3,835,191	4,144,254	4,623,523	4,575,510	4,115,726
Price of Anthracite Pig	$17.62	$21.50	$28.12	$25.12	$25.75	$22.38	$19.88
Tons of Steel Rails	491,427	610,682	852,196	1,187,770	1,284,067	1,148,709	996,983
Price of Steel Rails	$42.25	$48.25	$67.50	$61.13	$48.50	$37.75	$30.75
Importation, Tons	10	22,372	141,276	221,703	162,620	33,732	2,745

The price of pig iron averaged lower in 1878 than at any other time in our history. In September 1884 and March 1885, steel rails were sold at $26 per ton.

It may be doubted if more than our normal annual requirements of 6,000 miles will be built this coming year, which would require about 850,000 tons, but the renewals on between 140,000 and 150,000 miles of single track, much of which is still iron, will undoubtedly be heavy. It now looks as if we might attain a production fully equal to that of 1882, or an increase over the make of 1884 of about 300,000 tons.

As each ton of iron made requires a transportation, greatly by railroad, of coal, ore and limestone of about 4½ tons, this increased demand will make a sensible addition to our railroad tonnage. We regret that no statistics are available, showing the ton-mileage depending on our yearly make of iron; either the ore or coal is in most instances transported over considerable distances, and these items must be large even in the immense ton-mileage of this country.

All these indications seem to point to an increased traffic on our roads, and a consequent increased activity in building.

English vs. American Rails.

It was stated a short time ago in the money article of the *Times*, that an order for 10,000 tons of steel rails had been placed at Barrow for the United States. This statement excited some surprise, and figures were quoted to show that there must be some mistake. It was mentioned that $33 was the price for steel rails in America. In this country £4, 15s. ($28.18) was the figure fixed by the rail syndicate. Adding freight to the duty, ($17), British made rails could not be laid down at a port in the United States under $41. That is a difference of $8 per ton. Mr. J. T. Smith, formerly president of the British Iron Trade Association, in a letter to the *Times*, shows, however, that it is quite possible under present conditions, to ship steel rails to the United States. He says that not only is it true that the Barrow Hematite Co., has made a contract for 10,000 tons of rails for America, deliverable at New York but they have got 10*s.* per ton more from them than the current regulation price of the Steel Rail Makers Association. Mr. Smith adds that negotiations are now going on, which are expected to build up the business, and points out that the Americans would not pay over 50*s.* per ton more for English-made rails unless they were satisfied of their superiority in respect of wear over those made in their own country. This order is of special importance at the present moment, as it bears out what has all along been contended for by English rail manufacturers, that Vanderbilt would never have placed his heavy rail contracts in this country, unless he had been convinced that better value was to be obtained through the durability and superior quality of the English production.

The Engineer, December 4th.

In this country purchases made for exportation carry a discount of 5 per cent. on the market price so universally that at least 5 per cent. is not considered a point of negotiation. We have not had sufficient experience in purchasing in British markets to more than express our doubt that the Barrow people raised their home price over 10 per cent. to foreign purchasers, even when they are as well able to pay as the Chicago, Burlington & Quincy. We think Mr. J. T. Smith doth protest too much. There is no doubt however, that the company above named has placed an order for 12,000 tons at Barrow. It is not known that the general manager of that road has explained the reasons that induced him to go to an additional expense of $80,000 or more. He is reported to have said invariably that he had no explanation to make. If he thought they were nearly a quarter better, he probably would have said so.

Vanderbilt's last order is understood to have been for the Canada Southern, and while the Chicago, Milwaukee, St. Paul and Minneapolis Railroad is locating in Missouri, where will the C. B. & Q. be building next year?

To a person whose mind is fully seized of the foundation fact in political economy that trade or commerce is actuated solely by a desire to buy in the cheapest market, the statistics of the rail business for 1884 present some rather confusing items, for during the calendar year our business stood as follows:

Exports of iron rails	1,254 tons.
Imports " " "	94 "
Exports of steel rails	5,504 "
Imports " " "	3,074 "

As all the steel rails imported had to pay a duty of $17 besides freight, which may be assumed at $1, it looks as if there must have been either a considerable gain to the exporters or some loss to the importers. And it is remarkable that the officers of the Canadian Pacific R. R. not being "convinced that better value was to be obtained through the durability and superior quality of the English production," should have placed an order for 10,000 tons steel rails in Scranton, Pennsylvania.

The first steel rails imported, made by Brown, for which $180 in gold was paid, were undoubtedly good rails, and some of them are said to be still in use. They undoubtedly show longer wear than any American rails, that were made six years later.

THE SAVANNAH, DUBLIN & WESTERN SHORT LINE RAILWAY CO.—This company has been organized to build a standard gauge road from Savannah, Ga., to Americus, in the western part of the State. One corps of engineers is at present at work, and another will be started out very soon. The capital stock is $2,000,000, and it is proposed to build at least one hundred miles during the next year. Mr. A. B. Linderman is President; D. M. Hughes, Secretary; F. F. Johnson, Treasurer, and Arthur Pou, Chief Engineer.

Annual Report of the Secretary of War.

The report of Secretary Endicott, under date of Nov. 30, 1885, states that the total expenditures, appropriations and estimates for the fiscal year, ending June 30, 1885, were, as follows:

Salaries and Contingent Expenses	$2,072,806.48
Military Establishment	25,754,425.49
Public Works, including Rivers and Harbors	13,164,394.60
Miscellaneous Objects	4,859,372.97
Total	$45,850,999.54

The above figures include $71,778.72 credited to the subsidized Pacific railroads for transportation services, during 1885 and prior years, for the War Department.

The appropriation for the fiscal year, ending June 30, 1886, are, as follows:

Salaries and Contingent Expenses	$2,071,295.00
Military Establishment	24,288,337.50
Public Works	2,247,892.34
Miscellaneous Objects	3,154,888.56
Total	$31,762,413.40

The estimates for the year, ending June 30, 1887, as received by the Secretary, were $81,782,423.97; he has reduced these, as follows:

Salaries and Contingent Expenses	$2,057,765 00
Military Establishment	25,680,495.51
Public Works, including Rivers and Harbors	16,465,630.18
Miscellaneous Objects	4,000,292.79
Total	$48,204,183.48

The Lieutenant General reports that the army consists of 2,154 officers and 24,705 enlisted men. The report then treats of the active service of the army, the manner of promoting field-officers, etc., with which this journal has little to do.

The Secretary points out the defenseless condition of the sea-coast and lake frontier, as shown in the report of the Chief of Engineers reviewed in our last issue. The report of the Board on Fortifications, to be presented to Congress in January, will deal with the whole subject of coast defense.

The South Pass channel of the Mississippi river has been maintained as required by law; the total expenditure upon this work to Sept. 10, 1885, has been $5,150,000.

Satisfactory progress has been made upon the work for increasing the water supply of Washington, D. C. The dam across the Potomac river at Great Falls, is nearly completed. The tunnel has been excavated for a distance of 13,500 lineal feet, leaving 7,215 feet unfinished; though the contract calls for the completion of this work by June 30, 1886, this is not likely to be accomplished. Estimates submitted for the whole work amount to $590,000.

The Secretary reports that $800,000 could be profitably expended on the reclamation of the Potomac flats for the year ending June 30, 1887; $900,000 will have been expended on this improvement by the end of the present fiscal year.

Under the head of bridges over navigable waters the Secretary states that his department believes the bridge pier of the Minnesota & N. W. R. R., in the navigable channel of the Mississippi river at St. Paul, is an obstruction to navigation; this railroad bridge was not authorized by Congress, and the railroad company claim authority to erect under the act of the Territorial Legislature of Minnesota, of 1854. The U. S. Attorney General has decided that under the ruling of the U. S. Supreme Court, that until Congress acts and by appropriate legislation assumes control of the subject, the power of a State over bridges across navigable streams, within its limits, is plenary. The point in this case is that a private corporation acting under a Territorial Act is obstructing the main navigable channel of the Mississippi river, within a few hundred feet of the spot where Congress, in authorizing the City of St. Paul to build a bridge, provided that there shall be a span over the channel, leaving a clear water-way of not less than 300 feet. The Secretary calls the attention of Congress to this fact.

Under the head of the Ordnance Department, the report states that the Board on Fortifications will say in their forthcoming report that if Congress should make a sufficient appropriation to enable the Ordnance Department to advertise for the forging of, say, 100 10-inch steel rifles, the Board is quite certain that our steel manufacturers would provide the requisite presses, annealing furnaces, etc., within about one year, and they would begin to deliver the rough-finished forgings in six months afterwards, or say eighteen months from date of contract. They think it safe also to say that the new plant would be so designed as to handle forgings for 12-inch steel guns.

The Department, last spring, contracted with the Midvale Steel Co. for a tube, jacket and forged trunnion-hoop for an 8-inch steel breach-loading rifle; these are the largest gun forgings ever contracted for in this country, and the results are looked forward to with great interest. The Cambria Iron Co., of Johnstown, Pa., made the lowest offer for the 10-inch steel breach-loading rifle.

Messrs. Dupont completed, last year, their new and large press for the manufacture of prismatic powder with satisfactory results, and the fact is demonstrated that our own manufacturers can equal, if not excel, the best powders of Europe.

The 3.2-inch breech-loading steel gun designed by the Ordnance Board for field service has been tried to the extent of 1,800 rounds and to the satisfaction of the Board; the Department has contracted for forgings for twenty-five of these guns with the Midvale Steel Co., twenty of them are to be manufactured at the West Point Foundry and five at the Watertown Arsenal.

The Chief Signal Officer reports that the number of stations in operation on June 30, 1885, was 489. Telegraph reports were received daily from 160 stations, and, in addition, reports are received from twenty-five Canadian stations, from 375 voluntary observers, from fifty-two army surgeons, from 333 foreign stations and 655 naval and merchant vessels. The aggregate length of military telegraph line now operated by the Signal Service is 2,779 miles. The expenditure for the Signal Service for the year was $792,592.97, after deducting receipts from the military telegraph lines.

Secretary Endicott does not concur in the recommendations of the Chief Signal Officer asking for legislation to provide for a permanent detail of fifty enlisted men from the line of the army and the reorganization of the corps of signal officers by the appointment of a colonel, etc. The Secretary believes that the duties of the Signal Corps are civil, and not military, and that as it must ultimately become a civil organization, it would be unwise to give it the unbending discipline of a military body. He further says, the success of the service depends on the efforts of men engaged in technical study and its officers should be selected for their fitness for studious and scientific labor rather than for military ability and soldierly qualities.

Our Coast Defences.

As demonstrating the worthless character of our present fortifications on the sea-coast, upon which we must depend for the protection of about five billions in value of public and private property, and upon which works little or nothing has been done for more than twenty years, the following extract from a late lecture of Capt. Noble is interesting:

"Twenty-five years ago, our most powerful piece of artillery was a 68-pounder. Now the weight of our guns is increased from 5 tons to 100 tons, and the energies from 1100 foot tons to over 52,000 foot tons." It might be added to this that the projectile also has increased in weight from 68 pounds to 2000 pounds, and the range of certain modern guns has reached nine miles.

This enormous increase in offensive power demands a corresponding advance in our protective works, and forts built even to withstand the battering of the 500 pound shot of 1865 would be easily pierced by modern ordnance. Among the systems of modern fortification now being considered, metal seems destined to take the place of masonry: and steel turrets, fixed or revolving on land, or afloat in a harbor, and armored forts, are favorite methods proposed.

General Newton estimates that the proper defence of the important ports of New York, Philadelphia, Boston and Baltimore would cost $25,000,000; and if torpedoes and flanking defences be added, the expense would be $5,000,000 more. He would place four steel two-gun turrets at the Narrows below New York, mounted with 100-ton guns, and three such turrets on the East River.. The seven turrets would cost $600,000 each, or $4,200,000, and the fourteen guns in them, $100,000, or in total $5,600,000. He would also add twenty iron-casemated forts at the Narrows and ten on the East River; to cost $100,000 each, and to be armed with thirty 50-ton guns, costing $50,000 each; a total further sum of $4,500,000. In addition to all this should be thirty barbette disappearing rifles at the Narrows and on the East River, to cost $30,000 each, and thirty 20-ton barbette guns at $20,000 each, and 144 12-inch mortars at $17,000 each, with their emplacements. The aggregate for the defence of New York alone would thus foot up to $14,048,000; but while this sum seems great it is practically all involved in the first cost, the future maintenance costing comparatively little.

In this connection we would say that as an addendum to Capt. Bixby's official report on New Ordnance Material, now being published in this journal and which will be finished with the next issue, we have the permission of the War Department to also publish the same author's condensed report on Armor Material. This is a live subject just now, and Capt. Bixby has condensed into a few pages an interesting resumé of what has been done in this direction in Europe to a very late date, with an account of material used, method and cost of manufacture, and trials for endurance.

The Keithburg Bridge.

A corespondent sends us the following data relating to the Keithburg Bridge now under construction over the Mississippi river, at Keithburg, Ill., and to be used by the Central Iowa R. R.:

The bridge is to be of the Phœnix pattern, with one draw-span of 360 feet, one raft-channel span of 355 feet and seven fixed spans of 205 feet between centers; the approaches, are: East, three-fourths of a mile of embankment with 800 feet of trestle work next to bridge; West approach consists of 900 feet of trestle work, total length of structure, excluding embankment, 3,750 feet.

J. F. Molloer, C. E., has charge of approaches and made the preliminary surveys for location; Gen. Wm. Sooy Smith & Son had charge of subfoundations as subcontractors; and Drake & Stratton were subcontractors for the masonry. The superstructure is being erected by the Phœnix Bridge Co. who had the entire contract for the bridge proper. The general work is under the supervision of Geo. A. Lederle, as engineer in charge. Mr. Lederle was formerly with Mr. Geo. A. Morison and on the completion of the Keithburg bridge, goes to Omaha to take charge of the super-

structure of the new bridge being built over the Missouri river at that point.

The condition of work on the Keithburg bridge, on Dec. 8th, was as follows:—All piers completed; two spans erected and one-half of draw-span. The work of the erection has been much delayed by various accidents, one of which was the fall of the traveler used in erecting the first span west of the draw, by which three workmen were killed and five injured. On Dec. 4th, a derrick-boat was sunk during a heavy gale with a partial load of structural iron, and since Dec. 5th, heavy ice has been running in the river and has carried off the false-works in four spans. These accidents will delay the completion of the bridge from sixty to ninety days, but even with this delay the work has progressed faster than on any bridge yet built over the Mississippi river, excepting only the Sabula Bridge which was completed in 120 days.

The Central Iowa R. R. Co. anxiously awaits the completion of the bridge, as all of their heavy traffic must now be ferried over the river on a transfer steamer, and consequently every effort is being made to fight the ice and keep an open channel until the work is finished. The estimated cost of the Keithburg Bridge, including approaches, track, etc., is $500,000.

Panama Canal.

The *Bulletin du Canal Interoceanique* for Dec. 1, 1885, gives the total excavation in the month of October, on the Panama Canal, as 715,000 cubic metres, say 953,000 cubic yards; the total output to date is not given. The bulk of this work was done at Colon and Gatun and seems to have been dredging.

One of the great American dredges is reported to have excavated, in the month, a channel with a mean depth of 13 feet, width of 115 feet, and a length of 1040 feet; this was near Minxdi. Another American dredge working at Gatun advanced in the month 2060 feet, with a total cube excavated, of 133,000 cubic yards. "Another dredge" working at the same place is reported to have advanced only 561 feet, in *six* months.

The report only credits the Great Cut at Culebra with 38,000 cubic metres for the month; but says that the contractors there had a plant of 12 excavators, 9 locomotives, 1286 cars and 16,504 metres of track.

The Eruption at Krakatoa.

Shortly after the great eruption at Krakatoa, May 1883, the Dutch East Indian Government sent Mr. Verbeck to the Moluccas to investigate the history, causes and effects of the various phenomena.

Mr. Verbeck concludes that the disturbance was volcanic, not seismic, caused by the sudden influx of a large body of water to masses of incandescent matter in the neighborhood of the old volcano. This undoubtedly caused earthquakes over the region of the Moluccas and as far as Australia. The tidal wave was not caused, he holds, by the earthquakes, but simply by a fall into the sea of an enormous mass of ejected matter, estimated by Verbeck as equal to about 4½ cubic miles, some of which he thinks attained a height of over 30 miles. It is to this fine dust that he attributes the red sun-sets of the past two years. After the explosion the sea was covered with pumice stone some of which was found on the east coast of Africa, and another portion may be expected to reach the west coast of America early next year.

THERE are to be 4,500 electric lights of sixteen candle power each, and 4,500 gas lights in the new Indiana state house, and a gas light and an electric light will be put in every globe and an equal number of each in every chandelier, so that if one fails the other can be used, and if an occasion of special splendor comes along both can be used together.

TABLE NO. 1.

NEW YORK, November 1st, 1885.

Progress in Shafts at the End of Each Month up to Date.

SHAFT.	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.
0	——	33.0	156.5	210.0	Reached	Tunnel	at this	Point.			
1	5.7	22.5	56.6	116.0	164.0	198.0	247.0	324.0	333.4	Reached.	Tunnel
2	3.0	12.0	54.9	90.0	121.0	142.0	185.0	212.0	266.0	281.0	
3	13.5	66.0	86.5	128.0	152.0	197.0	242.0	311.0	350.1	Reached.	Tunnel
4	15.0	73.0	115.4	156.0	189.0	246.5	Reached	Tunnel.			
5	8.0	21.0	64.9	109.5	127.2	Reached	Tunnel.				
6	4.3	7.5	52.0	90.5	111.0	118.0	138.0	178.6	Reached	Tunnel.	
7	3.3	27.0	69.0	109.0	143.0	185.2	186.7	Reached	Tunnel.		
10	7.5	39.1	63.0	105.0	125.5	Reached	Tunnel.				
11 A	20.0	31.2	Reached	Tunnel.							
11 B	6.0	26.5	31.2	34.7	Reached	Tunnel.					
12 A	16.7	35.2	42.0	Reached	Tunnel.						
12 B	23.0	35.6	39.0	"	"						
13	7.0	39.1	61.0	102.0	154.5	Reached	Tunnel.				
14	——		28.0	28.22	Reached	Tunnel.					
15	18.0	49.0	83.0	118.0	126.6	Reached	Tunnel.				
16	18.0	36.0	53.0	72.22	Reached	Tunnel.					
17	21.0	49.9	59.7	Reached	Tunnel.						
19	14.0	34.0	67.8	"	"						
20	19.5	48.0	72.0	115.0	115.4	Reached	Tunnel.				
21	19.6	32.0	46.0	80.0	101.7	"	"				
22	19.7	40.0	53.0	80.0	80.6	"	"				
23	18.0	37.0	48.0	64.0	64.7	"	"				
24	37.5	63.0	77.0	91.0	110.0	134.0	158.0	176.5	Reached	Tunnel.	

Progress on the New Croton Aqueduct.

The following progress record in the shafts and tunnel headings of the New Croton Aqueduct, from the commencement of work to November 1st, is from authoritative data and can be depended upon. (*See table No. 1 above.*)

TABLE NO. 2.

NEW YORK, November 1, 1885.

Progress in Headings at the End of each Month up to Date.

SHAFT.	HEADING.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.
0	N.	.....	.....	.....	.....	.....	.....	.....	.....
	S.	.....	81.0	173.0	303.0	477.0	639.0	850.0	1025.0
1	N.	.....	.....	.....	.....	.....	.....	14.0	52.0
	S.	.....	.....	.....	.....	.....	.....	14.0	51.0
2	N.	.....	.....	.....	.....	.....	.....	——	——
	S.	.....	.....	.....	.....	.....	.....	——	——
3	N.	.....	.....	.....	.....	.....	.....	9.0	9.0
	S.	.....	.....	.....	.....	.....	.....	9.0	9.0
4	N.	.....	.....	.....	.....	37.0	42.0	108.0	236.0
	S.	.....	.....	.....	.....	44.0	44.0	105.0	225.0
5	N.	.....	.....	35.0	38.6	115.0	217.0	444.0	592.0
	S.	.....	.....	29.0	39.6	105.0	233.0	286.0	388.0
6	N.	.....	.....	.....	.....	.....	.....	22.0	65.0
	S.	.....	.....	.....	.....	.....	.....	22.0	70.0
7	N.	.....	.....	.....	.....	4.0	74.0	143.0	280.0
	S.	.....	.....	.....	.....	4.0	66.0	135.0	276.0
9	N.	.....	.....	.....	.....	128.0	295.0	461.0	655.0
	S.	51.0	153.0	312.0	470.0	637.0	802.0	944.0	1043.0
10	N.	.....	.....	15.0	33.5	119.0	198.0	360.0	551.0
	S.	.....	.....	17.5	24.5	97.0	176.0	366.0	561.0
11A	N.	97.0	178.0	271.0	475.0	671.0	909.0	1154.0	1374.0
	S.	.....	24.0	24.0	24.0	24.0	24.0	24.0	24.0
11B	N.	.....	32.0	43.6	43.6	43.6	43.6	43.6	43.6
	S.	.....	56.4	140.0	317.0	480.0	702.0	925.0	1130.0
12A	N.	23.0	46.8	90.0	195.0	251.0	358.0	428.0	528.0
	S.	.....	36.0	58.0	58.0	58.0	82.0	126.0	182.0
12B	N.	.....	.....	.....	8.75	8.75	8.75	8.75	8.75
	S.	24.0	68.0	120.0	216.0	314.0	359 0	518.0	590.0
13	N.	.....	.....	.....	30.6	51.6	51.6	75.6	211.6
	S.	.....	.....	.....	30.4	50.4	50.4	71.4	210 4
14	N.	.....	27.5	64.3	124.9	219.0	386.9	571.9	709.9
	S.	.....	24.0	23.0	23.0	33 5	33.5	33.5	54.1
14A	N.	.....	.....	.....	.....	.....	.....	.....	.....
	S.	18.5	71.0	149.0	251.0	376.0	550.0	747.0	846.0
15	N.	.....	.....	29.5	52.2	52.2	166.2	236.2	261.2
	S.	.....	.....	29.8	48.8	48.8	112.8	143.8	224.8
16	N.	.....	8.8	33.1	79.1	200.1	352.1	540.1	676.1
	S.	.....	15.8	46.9	101.9	226.9	395.9	580.9	739.9
17	N.	.....	50.0	120.0	257.0	409.0	617.0	773.0	815.0
	S.	.....	43.0	125.0	266.0	346.0	451.0	633.0	687.0
18	N.	.....	12.0	180.0	320.0	434.0	600.0	743.0	910.0
	S.	.....	20.0	176.0	250.0	306.0	327.0	407.0	450.0
19	N.	.....	31.0	80.0	120.0	228.0	274.0	302.0	359.0
	S.	.....	31.0	78.0	130.0	189.0	279.0	394.0	495.0
20	N.	.....	.....	29.0	62.0	186.0	410.0	633.0	816.0
	S.	.....	.....	56.0	60.0	105.0	234.0	395.0	539.0
21	N.	.....	.....	18.4	76.4	121.0	256.4	403.0	541.0
	S.	.....	.....	23.6	73.6	117.0	218.0	308.0	519.0
22	N.	.....	.....	72.8	121.8	195.0	307.8	462.8	682.8
	S.	.....	.....	63.2	111.2	161.0	261.2	419.2	590.2
23	N.	.....	.....	66.6	102.6	165.0	232.6	352.5	525.6
	S.	.....	.....	64.4	93.4	154.0	224.4	353.4	512.4
24	N.	.....	.....	.....	.....	.....	.....	36.0	122.0
	S.	.....	.....	.....	.....	.....	.....	36.0	75.0

Total progress in Headings to date..... 22541.35

TABLE NO. 3.

NEW YORK, November 1, 1885.

Average Monthly Progress.

SHAFT.	IN SHAFT.	IN N. HEADING	IN S. HEADING.
No. 0	70 feet.	——	146.4 feet.
1	37 "	26.0 feet.	25.5 "
2	28.1 "	——	——
3	38.9 "	4.5 feet.	4.5 feet.
4	41 "	59.0 "	56.2 "
5	24.4 "	98.6 "	64.6 "
6	22.3 "	32.5 "	35.0 "
7	26.6 "	70.0 "	69.0 "
9	——	163.7 "	130.3 "
10	25.1 feet.	91.9 "	93.5 "
11A	15.6 "	171.7 "	3.4 "
11B	8.7 "	6.2 "	161.4 "
12A	14 "	66.0 "	26.0 "
12B	13 "	1.7 "	73.7 "
13	30.9 "	42.3 "	42.0 "
14	14.1 "	101.4 "	7.7 "
14A	PORTAL.	——	105.7 "
15	29 5 "	43.5 feet.	37.4 "
16	18 "	96.5 "	105.7 "
17	19.9 "	116.4 "	98.1 "
18	——	130.0 "	64.2 "
19	22.6 feet.	51.2 "	70.7 "
20	23 "	136.0 "	89.8 "
21	20.3 "	90.1 "	86.5 "
22	16.1 "	113.8 "	98.3 "
23	12.9 "	87.6 "	85.4 "
24	22.0 "	61.0 "	37.5 "

Long Freight Trains.

The *Railroad Gazette*, for December 11th, notes a late "long freight train" performance on the Louisville, New Orleans & Texas Railroad, as very nearly, if not exceeding the greatest performance on record. The length of the train was 5,370 feet and it was made up of 150 loaded freight and two caboose cars, all hauled by one locomotive over about 100 miles of almost dead level track. The total weight of the train is stated as follows:—

	Total Tons.	*Tons per Car.*
Load (4,627 bales cotton).....	922.42	6.15
Dead weight, engine and train.....	1790.00	11.45
	2721.42	17.60

In this figure the engine is credited with sixty tons.

The *Gazette*, in comparing this performance with others on record, fails to note a late run made by a West Shore freight train that, in length of haul and weight drawn by one engine over 20-feet gradients, if not in length of train, is too remarkable to be ignored. In answer to a query, Mr. Walter Katté, C. E., Chief Engineer of the West Shore Railroad, kindly gives us the following data concerning the train referred to:—

The freight train was No. 106, of September 22nd, 1884, run from Buffalo to Weehawken. It consisted of sixty loaded cars of grain from Buffalo to Coeymans Junction; at this point fifteen additional cars were added, making seventy-five in all; at Kingston, one car was dropped, leaving seventy-four hauled from Kingston to Weehawken. The weight of this train was as follows:—

	Light Wht.	Cargo.	Total.
59 cars	715 tons	1,107 tons	1,822 tons
15 "	185 "	248 "	433 "
74 cars	900 tons	1,355 tons	2,255 tons

The "ton of 2,000 pounds" is used in these figures. The train was hauled by one engine with assistance at one or two points, such as getting in and out of switches and at crossovers in yards, etc. The average running time made was 13 miles per hour. On the West Shore R. R., on an east-bound trip, 50 loaded cars is an easy standard train.

Comparing the gradients and the total distance the train was hauled, with the Mississippi level line of about 100 miles, we find that the distance from Buffalo to Weehawken is 425 miles: for one-third of its length, this railway is level, and the prevailing maximum grade is 20 feet per mile going East and 30 feet per mile going West; and these limits are slightly exceeded for short distances. In alignment, four-fifths of the railway is straight, and though the designed maximum curvature was 4°, this curvature has been exceeded in several cases along the banks of the Hudson River.

It is worthy of note, in this West Shore performance, that the cargo carried was about one and one-half times the dead weight of the train. The weight of the engine itself does not seem to be included in the total weight.

Shipbuilding on the Clyde.

In spite of the over supply of ships universally acknowledged by the English who are the largest owners of such property, the capital invested in the business is too great to allow the industry to suffer more than a check. The launches from the Clyde ship yards for last November amounted to 13,485 tons, against 13,850 in November 1884 and 43,697 tons in the same month in 1883. The orders secured in the last week of November amounted to 18,000 tons. Twenty pounds per ton, which is accounted a fair average price for vessels, makes even the reduced figures seem attractive. About 90 per cent. of this sum goes to payment of labor and the balance to profits, rents, royalties and interest.

PERSONAL.

WM. M. HALL, late Division Engineer on the South Penna. R. R., has accepted a position as Engineer with Messrs. Collins & Farwell, contractors on the New Croton Aqueduct. His address is Kings Bridge, New York.

JAMES H. DARROW, a Brooklyn contractor, committed suicide in the Ballston, N. Y., jail on Dec. 11. Darrow was 66 years of age and formerly lived in Saratoga Springs, and built the Clarendon Hotel there. He had been convicted the morning of his death of assault in the second degree on John P. Freeman, of Saratoga Springs; he had been defended by N. C. Moak of Albany.

American Society of Civil Engineers.

At the regular meeting of the Society on Wednesday evening a paper was read by Capt. F. V. Greene, Corps of Engineers, U. S. A., M. Am. Soc. C. E., entitled, "An Account of some Observations of Street Traffic," which was afterwards discussed by several of the members. The paper is the result of extended observations in the interest of the Barber Asphalt Paving Co., and was very interesting. We will publish it in whole, or part, at an early date.

Engineers Club of Philadelphia.

At the regular meeting on the 5th, Mr. C. W. Buchholz presented a paper of more than ordinary interest upon "Engineering; its Achievements and its Reward." A view is taken—broad, historical and practical—of what the man of technical science has done for his fellow-men; of how essential he is to human progress, and of how his results and, more especially, he himself, are acknowledged and appreciated, when his share is allotted him by those who pocket the millions which are the direct proceeds of the creations of his intellect.

Prof. De Smedt's Cement Tests.

In the Annual Report of Chemist E. J. De Smedt, published in ENGINEERING NEWS of the 5th, page 364, two typographical errors have occurred which we now correct in justice to the party particularly interested, the American Improved Cement Company, of Philadelphia. We should have made two tables instead of one, and we herewith reproduce the table of "Light Burned Home Made Cements" in correction of the first error. The other and more serious error consisted in the printer dropping the figures 150 and 180 and 380 in the 6 months and 12 months columns so that they appear in connection with different brands of cement than those they belong to. The present table also corrects this error. The attention of Prof. De Smedt has been called to the error and by letter dated, December 15th, he has authorized its correction. A comparison of the tables of December 5th and the one herewith given will enable our readers to understand the importance of the corrections.

LIGHT BURNED HOME-MADE CEMENTS.

Name.	Fineness on Sieve No. 50.	Quantity of Sand and Cement.	1 day	5 days	10 days	15 days	20 days	30 days	60 days	6 months	12 months
Shepherdstown	0	neat	35	70	100	119	124	180	260	353	360
do		2 sand 1 cement.	.....	25	36	41	70	95	118	140	189
Round-top	5	neat	40	90	.....	109	150	205	259	360	380
do		2 sand 1 cement.	.....	20	30	40	72	100	120	150	180
Union	3	neat	70	120	150	250	295	315	.....	.....	.....
do		2 sand 1 cement.	.....	80	95	101	130	160	.....	.....	.....
Lawrence	5	neat	35	75	95	115	125	170	240	.....	.....
do		2 sand 1 cement.	.....	22	30	35	62	90	108	.....	.....

English Tramways.

Engineering, in a late editorial, gives the progress of tramway building in England, or street railways as we would call them. It seems that up to 1876 there were only 158 miles of tramways constructed in the United Kingdom at a total capital expenditure of £2,253,000. In 1882, six years later, the mileage had increased to 671 and the capital invested, to £9,750,000. This is an exceedingly rapid growth, and meant an increase of 325 per cent. in mileage and about 330 per cent in capital.

While the cost of construction has been very variable, the tendency has been of late years, as on railway lines, to an increase of capital expenditure per mile of line opened. The average cost of construction, in the United Kingdom, for the last seven years has been fairly uniform, varying in this time from £15,639 to £14,219 per mile.

Engineering remarks that while the above figures are very much under the average cost of English railways, which it puts down at £42,000 per mile, the reverse is the case in New York State, where there are nearly 500 miles of tramway in operation. The editor finds that for a total distance of 167 miles the expenditure has been about £54,000 per mile for the American lines; the extremes are represented by the Buffalo & East Side line at £5,324, and the Broadway & Seventh avenue roads at £99,700 for the 8 miles, and the "New York and Harlem line of 6 miles at £755,300 per mile." The Brooklyn city lines of 44 miles average about £15,570 per mile.

In the above estimate of the cost of the "New York & Harlem" line *Engineering* makes a serious error of computation by dividing the entire consolidated stock of the Manhattan Railroad Company, $23,618,400, by six miles, instead of 32.39 miles, which are really represented by that capital. The actual cost per mile of the Manhattan system, as figured from its capital account, and much watered stock, is $730,000, or about £146,000, and *not* £755,300.

From the Parliamentary returns, *Engineering* furnishes the following statement of expenditures in England and Wales to June 30, 1883:

	NUMBER.	TOTAL COST.	AVERAGE COST.
Horses	15,702	£311,165	£32.55
Cars	2,217	392 815	177.18
Locomotives	95	69.742	734.12

A comparison is also made between the working expenditures per mile of line open, of the railways and tramways of the United Kingdom, for 1883, as follows:

ITEM	RAILWAYS.	TRAMWAYS.
Maintenance of Way and Works	360	141
Horses,	499	1.341
Locomotive Power		26½
Repairs and Renewals	177	106
Traffic Expenses	599	695
Management		116
Rates, Taxes and Tolls	139	86½
Compensation for Personal Injury		37
Legal, Parliamentary	155	24
Other Working Expenses		53
Totals	£1.929	£2.626

From this it would appear that the average expenditure per mile of line open is about 36 per cent. higher on tramways than on the railways of the United Kingdom; the items of traction and traffic expenses being the chief causes of the increase, and they prove the greater cost of maintaining horses than locomotives.

If the comparison is made for the same year, however, *per train mile*, the result is very different, standing as follows:

ITEMS.	RAILWAYS.	TRAMWAYS.
Maintenance of Way and Works	£6.01	£0.54
Horses,	8.32	5.20
Locomotive Power		
Repairs and Renewals	2.95	0.40
Traffic Expenses	9.99	3.10
Rates, Taxes and Tolls	2 32	0.33
Compensation for Personal Injury	0.22	0.14
Legal and Parliametary Expenses	0.33	0.09
Other Working Expenses	2.04	0.20
Totals	£32.17	£10.00

The tramway mileage of 1883 was 33½ millions of miles. The editor finds that the working expenses of English tramways approximate very closely to those of Pennsylvania and Massachusetts lines of street railway per mile of line open. The net earnings on these American lines are, however, much greater than on the English roads; they average £6,629 per mile on 213 miles, while in the United Kingdom the average net earnings in 1883, were:

For England and Wales	£621½	or	$3,107.50
" Scotland	1,380	"	6 900.00
" Ireland	501	"	2 505.00

As in all countries alike, tramway receipts are almost exclusively derived from passengers; so in a total gross income of £2,211,973, in the United Kingdom in 1883, 93 per cent. was from passenger traffic, the remaining 7 per cent. being from parcels, mails, animals, etc. A tabular statement given for 1878-1883 shows that the recent tendency has been to reduce both the working expenses and the average receipts per passenger carried; the average receipts per passenger carried being in 1883, 1.8d., and the average working expense on the same basis, 1.42d.

South Penna. R. R., Cost of Tunneling Per Cubic Yard.

Concluded from page 371

Name of Tunnel and Character of Work.	Kind of Material, Position, etc.	DETAILS PER CUBIC YARD OF PRESCRIBED SECTION. Labor.	Plant, tools, etc.	Fuel, Oil.	Explosives.	Sundries.	Totals.		Prescribed Work in Sections in Cubic Yards per Lineal Foot. Heading.	Bench.	Bottom.	Total.
ALLEGHENY MOUNTAIN.		$	$	$	$	$	$	$	2.75	3.30	8.00	14.05
Breaking[1]	Red Shale; dip about 10° west; strike about 45° with tunnel axis.	1.44	0.27	0.18	0.61	0.32	2.82					
Loading and Dumping		0.88					0.88	3.70				
Transportation per 100 feet		0.012	0.013	0.003			0.028					
QUEMAHONING.		cents.	cents.	cents.	cents.	cents.	cents.		5.60	10.55	0	16.15
Breaking. Heading	Soft gray slate.	59.23	6.19	0.95	61.98	10.12	138.47					
Breaking. Bench	" with 8 in. coal vein	32.58	4.50	0.71	23.46	5 45	66.70	205.17				
Loading and Dumping. Heading to B.		16.43	0.30				16.73					
Loading and Dumping. Bench		34.71	0.65 / 12.80				48.16					
Transportation per 100 feet. Heading to B.		3.02	0.10				3.12					
Transportation per 100 feet. Bench		3.09	8.51				11.60					
NEGRO MOUNTAIN.		$	$	$	$	$	$		4.00	11.92	0	15.92
Breaking. Heading	Black slate and two feet coal vein	1.00	0.42	0.05	1.03	0.50	3.00					
Breaking. Bench	Hard gray slate.	0.40	0.17	0.02	0.34	0.17	1.10	4.10				
Loading and Dumping. Heading to B.		0.50					.50					
Loading and Dumping. Bench		0.40					.40					
Transportation per 100 feet. Heading to B.		Included in loading and dumping.										
Transportation per 100 feet. Bench		0.01					.01					
LAUREL HILL.									1.941	8.763	0	10.704
Breaking. Heading	Hard limestone, level bed.	4.37	0.71 / 0.12	1.02	2.79	0.55	9.56	11.03				
Breaking. Bench		0.60	0.08 / 0.01	0.10	0.58	1.10	1.47					
Loading and Dumping. Heading to B.		1.61					1.61					
Loading and Dumping. Bench		1.29					1.29					
Transportation per 100 feet. Heading to B.		Included in loading and dumping.										
Transportation per 100 feet. Bench		0.02	0.01	0.01			0.04					

[1] In connection with the above table the following explanatory notes are in order:—

The item of "Breaking" includes drilling, blasting, explosives and all expenses incurred previous to loading into barrows or cars. Where two amounts are placed in column of "Plant, tools etc.", opposite any one class of work, the upper amount represents, the "interest and depreciation on heavy plant, such as compressors, engines, drills, piping, track and cars;" the lower figure is the "cost of small tools and repairs and renewal of heavy plant." The item of "Sundries" includes "Superintendence, freight, transportation, etc."

The division of cost is made upon the prescribed tunnel-section for heading, bench and bottom, according to the system of working adopted and without regard to the actual amount of rock removed beyond the official section.

The cost of labor, plant, superintendence and explosives is given, when known, for each of the above Tunnels as follows:—

Allegheny Mountain Tunnel.

LABOR.			Average Number per Shift. 12 Shifts a week, one end.
Foremen	per day	$3.00	3
Drillers	" "	2.00	12
Laborers	" "	1.40	35
Locomotive Engineer	" "	2.50	1
Mules	" "	1.25	1
Machinist	per month	125.00	0.25
Asst. "	per day	2.50	0.50
Firemen	" "	2.25	0.50
Blacksmiths	" "	2.50	1
Helpers	" "	1.75	1
Water boys	" "	1.00	2
Blasters	" "	2.25	1
Carpenters	" "	2.50	1
Stablemen	per month	60.00	0.50
SUNDRIES.			
Superintendent	per month		$300.00
Timekeeper	" "		60.00
Bookkeeper	" "		100.00
Freight and Hauling	" "		750.00
FUEL, ETC.			
Fuel and Oil	" "		940.00
(Bituminous coal delivered at about $2.00 per ton.)			
EXPLOSIVES.			
Dynamite (40 per cent.) at per lb			0.25
PLANT, ETC.			
One 20 × 30 in. Ingersoll air-compressor, new			
One 16 × 20 in. " " "			
Two 12 × 15 in. Burleigh " old			
One 50 H. P. Boiler			
Two 25 H. P. "			
Two 20 H. P. "			
2,000 lin. ft. of 3½-in. Pipe.			
9,000 lin. ft. of 3-in. "			
Total value			$27,000
Two Locomotives of 25 H. P., the two			7,000
Buildings			2,500
Miscellaneous Plant			6,000
Temporary Track			4,200
Air-drills, (12 in average use) at $400			4,800
Total			$51,500

Interest and Depreciation included in above.

Quemahoning Tunnel.

The labor items, etc. for this t nnel are returned as follows:—

LABOR.		
Superintendent	per day	$3.00
Foremen	"	2.50
Drillers	"	1.50
Helpers	"	1.50
Muckers	"	1.15
Blacksmith	"	2.00
Horse and Driver	"	2.00
Cars	"	50
Boy	"	50
EXPLOSIVES.		
Dynamite (40 per cent.)	per lb	$ .22½
Caps	per box	1.00
Fuse	" foot	.01¼
SUPPLIES.		
Steel	per pound	.10
Oil for Lamps	per gallon	.20
Oil, axle	" "	.10

Negro Mountain Tunnel.

LABOR.		
Superintendent	per month	$125.00
Foremen	" day	2.50
Heading Men	" "	1.50
Muckers	" "	1.15
Blacksmith	" "	2.50
Helper	" "	1.50
EXPLOSIVE.		
Dynamite, (40 per cent.)	per pound	.20
SUPPLIES.		
Steel	" "	.10

NOTE: This tunnel had a 2ft. coal vein running through the heading at the time of making report.

Laurel Hill Tunnel.

LABOR.		
Superintendent	per month	$150.00
Foremen	" day	2.75
Drillers	"	2.25
Helpers	"	1.75
Muckers	"	1.40
EXPLOSIVE.		
Dynamite (45 per cent.)	per pound	.25

BUSINESS.

There was a man once on a time who thought him wondrous wise,
He swore by all the fabled gods he'd never advertise;
But the goods were advertised ere long, and thereby hangs the tale—
The ad. was set in nonpareil, and headed "Sheriff's Sale."—Salem *Gazette*

CORRESPONDENCE.

Artesian Wells.

JACKSONVILLE, FLA., Dec. 11, 1885.

ED. ENGINEERING NEWS:—Having read with much interest the accounts of various Artesian Wells sunk recently, I will give you some data in regard to the wells of Florida. This city is now entirely supplied from artesian wells, we have two down and a third one in progress. The first one sunk was 3 inches in diameter, 490 feet in depth, and flows 180 gallons per minute; the second, completed a month ago, is 6 inches in diameter and 635 feet in depth, and flows 600 gallons per minute, the two together furnishing 1,123,200 gallons in twenty-four hours. The water is a milch sulphur, containing about 23 grains of mineral matter, no organic, is 4.8 degrees of hardness, temperature as it flows from the wells, 74 degress Fahr., pressure on well when closed, 26 pounds per square inch. A number of wells have been sunk along the St. Johns river at St. Augustine and Palatka, and good supplies of water obtained at depths varying from 290 to 635 feet.

Yours truly, R. I. ELLIS,
City Engineer.

Through the West.

Special Correspondence ENGINEERING NEWS.

OMAHA, Dec. 15, 1885.

MR. CLEM. HACKNEY, formerly Assistant Superintendent of Motive Power on the A. T. & St. Fé. Ry., has been appointed Superintendent of Motive Power and Rolling Stock of N. P. Ry., in place of I. E. Congdon, resigned. Appointment taking effect November 1st. Mr. Congdon has been with the N. P. for several years and has made several valuable inventions, one of which is the Congdon Brake-shoe.

The eastern caisson of the new N. P. bridge across the Missouri at Omaha is completed and the sinking will commence very soon. Mr. H. W. Parkhurst is in charge of work at Omaha. Mr. Geo. Morison is the Chief Engineer.

Omaha is calculating on building a new City Hall, a Board of Trade building, three new Bank buildings, and a Y. M. C. A. building, in 1886.

The Northern Pacific will build from their main line a branch to Butte, Ma. The U. P. Ry. have threatened to extend their Utah Northern branch to Helena, Ma., in return.

Denver is experimenting with an Electric Railway. Track has been laid about three miles, up 15th street and out on Capitol Hill. Professor Short, of the Denver University, is the inventor and superintendent. Ex-Governor Evans, Rodney Curtis, and other capitalists are stock holders. A.

Through Illinois.

Special Correspondence ENGINEERING NEWS.

CHAMPAIGN, ILL., Dec. 15, 1885.

The Thompson-Houston company has put in an electric light plant at Bloomington, Ills., with a capital stock of $35,000. The total capacity is 150 lights.

James Lillie was awarded the contract for the con-

struction of the new hospital building at Kankakee, Ill. They are to cost $116,315.

THE I. & I. S. R. R. is building a new bridge over the Wabash river.

THE foundations for the Illinois Reform School, at Pontiac, are completed, and covered up for the winter.

DECATUR, ILLS., claims that the coal from the mine recently opened there, is the best in the state.

DECATUR, ILLS., is soon to be lighted with the Jenny electric light.

ANOTHER gas well, the strongest yet developed, was opened near Mendota, Ills., about a week ago. This field is being rapidly developed.

THE supervisors of Tazewell county Ill., have been petitioned to appropriate $1,200 toward building highway bridges in Malone township, that county.

THREE townships of Vermillion county, Ill., petitioned the county supervisors for aid in building four or five highway bridges, which petitions were laid over on account of technicalities.

A NATURAL gas explosion in a residence of Canonsburg, Pa., destroyed the house and injured several numbers of the family, but none fatally.

IN the case P. J. Sexton, the contractor who built the Cook County, Ills., Court House and who sued the county for $200,000 damages, the jury gave a verdict for $134,954.

ORDERS have been issued by the Board of Directors for the grading and bridging of another division of the Atlantic & Pacific R. R., from Red Fork, I. T., to Albequerque, N. M.

EDGAR P. TOBEY and other Chicagoans have secured incorporation papers for the Electric Railway Company with a capital stock of $3,000,000 to construct and operate tracks on, above, or below the surface.

MAJOR MILLER, U. S Engineering Corps, has been making a tour of inspection of the highway bridges over the Wabash river, and has condemned a number of them, the bridges being too low, or the draws not in the right place. The County Commissioners of a number of counties are reluctant to order them changed.

COAL IN ILLINOIS.—Eureka Ills., is boring for coal again, after having spent $3,500 in the same line about two years ago without finding coal. Tuscola, the same state, having bored one hole nearly 800 feet in which the drill got fast, has completed another 1,000 feet deep without finding. Judging from the many items similar to the above, we conclude that Illinois is illustrating the "penny wise and pound foolish" proverb by not having a thorough geological survey of the State. Enough shafts have been sunk and borings made, together with the profiles of the many railroads crossing the state in every direction, to give sufficient data to define the coal measures far more nearly that they seem to be. B.

News from Many Lands.

Compiled from our Exchanges.

From *Colonies and India* of the 4th we abstract the following interesting items.

The Cape of Good Hope Diamond Mining Company is now a thing of the past. The whole of the property, consisting of forty-nine claims and forty-nine acres of depositing ground, together with the machinery, plant, and effects, was put up at auction, in the City of London, on November 27, and after a very languid competition was sold for £3,400.!

THE steamer *Arawa*, 5,025 tons, has just arrived at Plymouth after another very fast run from Auckland, New Zealand, in 38 days 10 hours 48 minutes. Her frozen meat was in splendid condition.

THE work of connecting the West Coast of Africa by telegraph with Europe on the one hand and Cape Colony on the other is progressing satisfactorily. Even more satisfactory is the announcement that the Government is prepared to receive tenders for the construction of a telegraph cable between Halifax (N.S.), Bermuda, and Jamaica. This is only part of a large scheme which the Government is said to have in contemplation for placing all parts of the Empire into more or less direct telegraphic communication with each other and with England. Not the least important of the various links in such a chain is that which would connect Canada, with Port Hamilton and Hong Kong, and consequently with India and Australasia.

THE latest news from the Transvaal gold fields is very encouraging.

THE RAILWAYS OF VICTORIA.—The annual report of the Railway Commissioners had been laid before Parliament. It dealt with the working of the railways since the commissioners took office eighteen months ago. The result of the first six months of management showed the net earnings to be equal to 2 per cent. on the capital expended upon the construction of railways, namely, 21,893,385*l*. The gross revenue for the financial year 1885 was 2,181,932*l*, and the working expenses 1,277,425*l*. leaving a net revenue of 904,507*l*., which was equal to 3.95 per cent. on the capital of railways open for traffic, and 4.54 per cent. upon the expenditure out of debenture capital upon railways open for traffic.

THE TRINIDAD PITCH MONOPOLY.—This question has for some time occupied the attention of Trinidadians, and it has been respectfully urged on the immediate attention of Sir William Robinson. Instead of the paltry 1,500*l*. that the Treasury receive from the lake, it is felt that, properly worked, it ought to give a revenue more like 15,000*l*. per annum. Various schemes for working have been propounded, a correspondent suggesting the establishment of a convict labor depot, and utilising convict labor in digging.

THE contract for the construction of the ironwork of bridges on the Hergott and Strangways Springs Railway, South Australia, had been let to a colonial tenderer, Mr. Edwin Smith, of Fort Adelaide, the price being 15,554*l*. 1*s*. 9*d*. Five South Australian firms tendered for the work, Mr. R. Lindsay heading the list with 20 174*l*. 1*s*. 6*d*.

Herpath's Railway Journal of the 5th says: "Respecting business prospects generally the evidence adduced before the Royal Commission on Depression in Trade shows two things—that other countries are fast beating us out of the foreign markets, and that hostile tariffs play a large part in this. Protectionists will draw their own weapon from this. Fair traders will adduce theirs. Whilst all the wrangling is in progress trade suffers. All that remains for manufacturers is to make the best fight possible, and towards this workmen should cordially co-operate. If the men in the iron and allied trades do not go halves in making sacrifices, the day will come when trade will have vanished from the country. Full time should be given for reasonable wages.

THE revenue of the Great Russian Railway in September amounted to 3,789,197 roubles, showing an increase of 26,640 roubles as compared with September, 1884. The aggregate revenue of the Company in the first nine months of this year amounted to 30,145,412 roubles, showing a falling off of 204,190 roubles as compared with the corresponding nine months of 1884. The system of the Great Russian comprises three lines, viz, from St. Petersburg to Moscow, from St. Petersburg to Warsaw, and from Moscow to Nijni-Novgorod.

THE South African Railway to Kimberly has been opened by Sir Hercules Robinson amid great enthusiasm.

The *Iron and Coal Trades Review* of the 4th says:

"The Continental iron and steel trades continue to be little affected by the influences that are operating in the United States and Great Britain. The French railway companies are distributing orders rather more freely, and an order for 21,000 tons for the Orleans Company, has been placed at as low a figure as about 113 fr. delivered, or 105 fr. at works, whereas it is not long since it was declared to be impossible to manufacture rails profitably under 180 fr. The French imports of iron and steel during the first ten months were only 205,625 tons, against 271,018 in 1884, and of iron ore 1,183,643 tons against 1,144,065 tons in 1884. In Germany there is a slight improvement in Westphalia, but in Silesia trade is as bad as ever. The Silesian makers of spiegel pig have at last established a syndicate which is to continue in force for three years. The orders are to be "pooled" and distributed in the ratio of this year's production. Railmakers are rather better off, and their prospects are declared to be improving. An official return shows that the number of persons employed at the collieries in France is 111,317, of whom 89.1 per cent. are men, 4.6 per cent. women, and 6.3 per cent. children. Two-thirds of the men are underground.

A good deal has been said of late about the improved state of trade in the United States, and this has led to considerable speculation on this side. The increased railway traffics have enabled the managers, who had to economize almost too much during the last twelve months, to order freely, and it is calculated that they have already bought half of what they will require during 1886; a movement which has caused a rush up of the price of steel rails. Never before have they bought so largely ahead. But it must not be forgotten that it is only in steel rails and railway materials that briskness is noticeable, all other departments of the iron trade, except pig iron—which is affected by the animation in rails,—being as dull and apathetic as ever, and the competition is very keen, there being so many producers hungry for orders. Large purchases of Bessemer pig iron have necessarily been made, and a considerable quantity of English hematite has been contracted for at less than £4 per ton delivered. English spiegeleisen has also been bought rather freely, for the supply is short. The American railmakers have a combination like the International Railmakers' Association in Europe. It had only arranged for a production of 800,000 tons for next year, but the provision will certainly have to be enlarged, seeing how things have turned out lately."

A leading article in the London *Times* of the 25th ult., after discussing the position and prospects of trade and industry in the United States, states:

"A moderate rise in prices in the United States will doubtless send orders over to this country by scores, and it will be many months before the American works will be able to take up all the business themselves. Cheering as the prospect is, however, our ironmasters and manufacturers will do well to remember that the situation is not one on which a big speculation can safely be based. A moderate rise in prices is all that can be expected, considering the enormous stocks held here and the number of furnaces, rolling mills, and forges ready to start into activity all over the world."

TENDERS are required for the Hyderabad Sind Municipal Waterworks, a steam pumping engine, complete (without pipes) with all the latest improvements regarding economy of consumption and maintenance capable of delivering 85,000 gallons of water per hour easily at a slow speed, on a total lift of 90 feet, or say depth of suction 20 feet, and height of delivery 70 feet. The steam engine to be worked by an existing locomultitubular boiler, with 375 square feet of effective heating surface, and now doing the work as above described (with wood fuel) with a pressure of 50 pounds per square inch. Apply, sending plans, showing suction and delivery pipe, connections to pump, as also steam and exhaust pipe connections, with the respective diameters of each of their passages, and with price free on board, and insured, by British India Steam Navigation Company's steamer to Kurrachi, to the Collector and President, Hyderabad Municipality, Hyderabad Sind. Tenders will be received up to 28th February, 1886.

THE Spanish paper *El Dia* announces that the approaching budget will include a sum necessary for the purchase of ten torpedo boats, twelve large cannon, also the arming in Spain of 7 frigates, two war vessels of the second class, three war vessels of the third class and eleven clippers.

TENDERS for the supply of about 50,000 tons of cast iron pipes, from 36 inches to 48 inches, diameter for the Manchester Corporation, in connection with Thirlmere Aqueduct, were opened on the 10th at the Town Hall, Manchester.

THE *South American Journal* learns that a new railway is being construc ted from Puerto del Sauce, starting from the important stone quarries there, where "adoquines" are made for Buenos Ayres and La Plata. It is said that it will be extended eventually to the Rosario colonies.

VICTORIA intends to borrow £8,000,000 in the near future, £6,000,000 of which are for railways, etc. About £2,000,000 will probably be raised next year.

AT the commencement of September, 1885, Russia had 23,628 versts of line in operation, as compared with 22,682 versts at the corresponding period of 1884.

AN English company is stated to have made proposals to the Greek Government for the construction of a line from the Piræus to Larissa. The estimated cost of the line is £2,800 000.

WATER

CONEY ISLAND is to be sewered.

SIOUX CITY, Ia., is figuring on cost of street paving.

NORFOLK, VA., has appropriated $18,000 for extension of water-works.

COVINGTON, VA., is applying for permission to build water-works.

THE Ellendale, Min., artesian well was commenced this week. Pipes to be laid in the spring.

LACHINE, near Montreal, voted on the water-works question on the 10th.

CRESTED BUTTE, COL., is to be lighted with electricity.

THE Atlanta, Ga., artesian well is 2,500 feet deep and delivers 200,000 gallons daily.

THE Blair, Neb., waterworks will be in operation in a few days.

WARREN, O., voted 249 to 200, on the 1st against waterworks. The subject is indefinitely postponed.

BUTLER, in Bates county, Mo., and Trenton, Mo., are going to build water-works.

ELECTRIC lights to the number of 145 have been put in use in the streets at Bloomington, Illinois.

J. A. CLOUD, who built the Jacksonville, Fla., waterworks and sewers, is erecting the electric light plant for that city.

DAVIS & FARNUM, of Waltham, Mass., have the contract for the plant of the Palatka, Fla., Gas Light and Fuel Co.

THE contract for the construction of the Minerva, O., waterworks was let to the Pittsburg Gas and Water Construction Company, at $11,478.

ATLANTA, GA., and the East Tenn., Va., and Ga. R. R. Co. are at loggerheads over the supply of water from Dodd's Creek. An injunction has been served against the railroad company.

THE Middleboro, Mass., water works were officially tested on the 15th. Pressures sixty-two to eighty-seven pounds per square inch. Cost of works $70,000. We will give further particulars next week.

THE city of Boston will accept the Worthington high service engines. The committee "are of the opinion that the price charged the city was not excessive, and that the contracts were correct and proper."

THE Union League Club has appointed a committee of twenty-one, "with power to investigate carefully into the matter of water supply in different cities, and to appear before the Aqueduct Board and make such suggestions as they may deem proper."

MAYOR S. McDOWELL, W. A. Wagner, city clerk; Willis Ball, city engineer, and the entire board of aldermen, of the city of Beatrice, Neb., have been visiting the Leavenworth, Kan., water-works, preparatory to building for their own city.

INITIAL steps were taken in the Milwaukee, Wis., Common Council, December 7th., for the establishment of a new reservoir and pumping-works at Whitefish Bay. City Engineer Benzenberg has asked for the purchase of 5,000 tons of water-pipe for use next year. The cost will exceed $100,000.

ENGINEER CHARLES E. FOWLER, of Tarrytown, reports to the village trustees that the village can be supplied with water from the Pocantico River at a cost of $95,000. This will place hydrant water in every house in Tarrytown. The people of that municipality will soon vote on the question of water or no water.

THE Newark, N. J., Street Committee, on the suggestion of Watts, Campbell & Co., contractors, for the pumping station of the big sewer, will recommend the addition of heaters, hot water pump, at a cost of $4,000 to the pumping station, thereby increasing the capacity of said station from 55,000,000, to 72,000,000 foot pounds without additional cost of fuel.

Controller Loew, of this city, has awarded $2,000,000 additional water loan stock. The bonds run twenty years and bear 3 per cent. interest. The premiums aggregated $53,000, and, with the principal, has been paid over to the City Chamberlain. The Controller is much pleased at having placed the loan so advantageously.

PLANS and estimates for water-works at East Glasgow, N. S., have been prepared by E. H. Keating, the city engineer of Halifax. Two disconnected pumps of 750,000 gallons daily capacity each, and a reservoir of 2,500,000 gallons at 300 feet above tide water are proposed. 31 hydrants for fire service. Cost to be about $60,000.

THE Hyde Park water-works contract, over which there has been a bitter fight, has been awarded finally to the Holly Manufacturing Co., and the bond of the company for $75,000 fully approved by the Village Council. The payments shall be as follows: January 1, 1886, $12,500; upon delivery of engine, $12,500; upon starting of engine $12,500; upon completion of satisfactory twenty-four hour test, $13,500.

VINELAND, N. J., is to have water-works. Charles Keighley, a maunfacturer, having contracted to put up the machinery and lay all the mains as a private enterterprise. Water is to be supplied by a system of drive wells, eighty in number, which have been sunk on the premises adjoining the factory. A Holly pump, of 1,000,000 gallons a day, will be used, although the present needs of the borough will not require more than one-quarter or one-half that amount. The work of laying six miles of pipes will begin in a few days.

ANN ARBOR'S NEW WATER SYSTEM.—The formal tests were made on the 5th by the Ann Arbor Water Company of their machinery and system, from which Ann Arbor is looking for her future water supply, which is one of the final terms of the contract preparatory for the acceptance of the system by the city. The contract between the parties is notably weak on several important particulars; no provision being made as to the quality of water, only that it should be wet; no specification being made as to the kind of an engine to be used, and in other respects the contract is so framed that were the company disposed they could lessen the expenses of construction by $7,000. Under the contract, water from the Huron river could have been used for the supply; an engine substituted for the Knowles' duplex costing over $1,500 less, and the city would have been obliged to accept the work. But in every particular the company has not only taken no advantage, but has supplied the first quality of buildings and machinery, and has secured at a great expense a supply of pure spring water unequaled by any water-works in the State.

The city pays the company $40 per hydrant for 100 hydrants, and $500 for two public drinking fountains and the public school supply. The principal stockholders of the company are Goodhue & Birnie, of Springfield, Mass. A Davison smoke-consumer, the invention of C. B. Davison, of this city is attached to the boiler, the company being one of the first to adopt it and appreciate its merits. The tests were all satisfactory, the reservoir pressure alone throwing six streams nearly 100 feet high at one time on Main street.—Detroit *Free Press*.

THE Lansing, Michigan, standpipe has risen 124 feet heavenwards.

THE flow of gas at Ottawa, Ohio, in the Beckman well continues undiminished, the quantity per day being 300,000 cubic feet. Oil is rapidly rising in the well, and pipes are being placed therein to draw off the oil, and thus separate it from the gas.

THE vexatious, old-time water works question, which has been a thorn in the side of the City Council of the City of Mexico, has been at last amicably adjusted. The rights held by A. de Medina and Salvador Malo have been relinquished under consideration of $200,000 paid to these gentlemen by the City Council.

By the payment of the $200,000 the old works contract has been rescinded and the Chapultepec reservoirs and machinery have come into the possession of the City Council with a clear, clean deed. This guarantees an abundant supply of good water to Mexico for the future.—*Two Republics*, October 17.

THE new project for supplying the village of Sing Sing, N. Y., with pure water for fire and domestic purposes has been submitted to the authorities. The original idea of bringing the water from Rockland Lake across the Hudson in pipes laid at the bottom of the river has been abandoned, and the new one, which provides for getting the water from the Croton river, in the vicinity of Quaker Bridge, submitted. This latter plan is regarded as more feasible than the former, and the source of supply is only about two miles away. It is also almost one-half cheaper, it being claimed by those taking it up that it would not cost more than about $150,000 at most to introduce the water into the village, whereas the Rockland Lake project would cost at least $250,000 to $300,000.

A SEWER in which a number of men were at work at Chester, Pa., caved in on the 10th, and buried four of them, killing Thomas McTamany and seriously injuring the other three.

A similar accident occurred at Akron, O., on the 9th; eight persons were buried; probably all will die. This accident occurred in an excavation being made for a large sewer, the channel being 22 feet deep. A large force of men were at work on a platform in the ditch and others on the bottom. Without warning, the braces which held the plank walls of either side gave way, and an immense mass of earth and timber caved in upon the men below. As the victims realized that they were being buried alive, the air was filled with heartrending cries for assistance, which the bystanders were unable to render, for the whole street, including the sidewalks, gradually slid down into the excavation.

THE new Holly-Gaskill pumping engine for the Buffalo N.Y., water-works was tested recently, by Mr. J. W. Hill, the Cincinnati expert mech. engr. As to the result, Mr. Hill, in his report says: "Comparing the contractor's guarantee and actual performance of the pumps, we have: Guaranteed capacity in 24 hours at 120 feet of piston speed per minute, 15,000,000 gallons.

"Actual capacity of pumps at piston speed of 120 feet per minute—15,588,209.97 gallons; excess of capacity over contractor's guarantee 588 209.97 gallons per diem, which is nearly four per cent, of guaranteed capacity." He then states that a subsequent test of capacity was made for one hour, running at an average speed of 18 revolutions per minute, which gave a daily delivery at the rate of 18,626,256 gallons, showing an excess above the nominal capacity of pumps of 3,626,256 gallons per diem.

Mr. Hill then gives a comprehensive report of the trial of duty. The revolutions in 48 hours were 42,977; revolutions per hour 895; per minute, 14; piston speed, during 58 hours, 118,848; mean head, by water pressure gauge, 193 readings, 79,700 pounds. The average pressure of steam was 80,276 pounds. The average corrected steam pressure was 80,204. "Comparing the contractor's guarantee and actual performances of the machinery for duty, we have: guaranteed duty per 100 pounds of coal burned during 48 hours of contract trial 100 000,000 foot pounds. Actual duty per 100 pounds of coal burned during 48 hours of trial, 107,638,148,482 foot pounds. Excess of duty over contractor's guarantee, 7,638,148,482 foot pounds, or over 7.6 per cent.

"Upon completion of the 72 hours operation for duty and capacity trials, the bearings all around the engine were examined, and none found warmed. The general performance of the engine during the trial was very satisfactory, and I venture the opinion that the continuous operation of the machinery will be satisfactory to your board, and be beneficial to the water department."

The total amount of coal burned during the capacity trial of 24 hours was 27,225 pounds. The amount burned during the duty trial of 48 hours was 51,808 pounds.

THE Highway Committee of the City Council of Newport, R. I., having requested Mr. Samuel M. Gray and Mr. Eliot C. Clarke, to act as consulting engineers in respect to the sewerage system of that city, now being carried out, these gentlemen report practically as follows in answer to specific questions put to them: That the changes made in the Chesbrough-Colton plan by the present engineer, Mr. Bentley, are improvements, inasmuch as they are more economical; that the proposed sewer outlet on piles will need further protection against the teredo and the force of wind and waves; that as to size, shape, and as a temporary economical expedient, the present plan of outlet is suitable with the protection mentioned. The experts very decidedly doubt that the piles will ever become so "saturated with sewerage as to protect them from worms," as suggested by the committee, but in almost all particulars endorse the present plans of Mr. Bentley as retaining the chief features of the original scheme, but as tending to carry them out more economically; they advise, however, that 10 per cent. be added to the estimated cost in view of the rise in prices during the past year.

BIDS, December 9, 1885, for furnishing Detroit Water-works 8,000 4-inch, 5,000 6-inch, 1,110 8-inch, 250 24-inch, 325 30-inch pipes:

	4 in.	6 in.	8 in.	24 in.	30 in.
Emaus Iron Works, Emaus, Pa.	26.25	26.25	26.25		
Warren Foundry & Machine Co., New Jersey.	28.25	27.00	27.50	24.20	24.20
Hiram H. Fisher, Allentown, Penn.	28.25	27.50	27.50		
R. D. Wood & Co., Philadelphia	27.68	27.32	27.32	26.43	26.43
A. H. McNeal, Burlington, New Jersey	30.90	30.22	30.00	27.68	27.68
Gloucester Iron Works, Philadelphia.	28.79	28.79	28.79	27 00	27.00
Dennis Long & Co., Louisville, Ky.	33.00	33.00	33.00	30.00	30.00
Geo. B. Hayes, Buffalo..	30.00	30.00	30.00	30.00	30.00
Cincinnati & Newport Iron & Pipe Co.	28.20	26.45	26.45	24.43	24.43
Lake Shore Foundry, Cleveland	28.00	26.25	26.25	24.30	24.30
Ohio Pipe Co., Columbus, O.	30.50	27.50	27.50		
Detroit Pipe & Foundry Co., Detroit	24.65	24.65	24.65	24.65	24.65

DRAINAGE AND SEWERAGE OF LAKE, ILL.—Benezette Williams and R. E. Brownell, civil, hydraulic and sanitary engineers, of Chicago, have just issued a report upon the drainage and sewerage of this important suburb of Chicago. The area is thirty-six square miles; population in 1885 50,000. The system proposed is one providing separately for storm water and sewage removal; both will be disposed of by discharge either into the existing Chicago system, into the Illinois and Michigan Canal or the Stock Yards slip. Some low-lying portions will require pumping. The sewerage system proposed is based on a population of 30,000 per square mile, and consumption of 120 gallons of water per head, with one-half more added for subsoil water; the sewers are calculated to carry when running, full 50 cubic feet per hour per acre. The Shone system is recommended for future demand in certain portions of the territory. The drainage system is designed to carry $\frac{1}{2}$ inch rainfall per hour; as the ground is very absorbent and the heaviest rainfall occurs in the dryest months, this capacity is considered sufficient. The roof water from houses is to be passed into the street-gutters and thence to nearest street-basin. The estimate of cost for present work is $155,916. The report includes maps and detail on sewage disposal and the cleansing of the South Fork.

A REPORT of the State Board of Health to the Nyack, N. Y., Board of Health, declares that Oak Hill Cemetery is polluting the water of the ponds and wells of that village, and that the further extension of the cemetery is "to be deplored on sanitary grounds." Dr. Carroll's report includes the reports of Civil Engineer Horace Andrews and Dr. William Hailes, Jr., the latter having made an analysis of specimens of water collected in Nyack on November 1st, by Mr. Andrews. Dr. Hailes reports:

ALBANY, Nov. 11, 1885.

DR. A. L. CARROLL.

Dear Sir:—Upon biological analysis of specimens of water sent to me from Nyack on November 1st, I report as follows: No. 1.—Well water at Rockland College. No. 2.—Spring water near ice pond. No. 3.—Well water near barn, Oak Hill Cemetery. Date of culture, November 2. Time of first appearance of micro-organisms, 36 hours. Time of beginning of liquefaction of gelatine, third day. Extent of liquefaction of gelatine in five days, entirely destroyed. The colonies of bacteria were very numerous, developing rapidly and liquefied the gelatine very quickly, and consumed the whole mass. Parts of chlorine in 100,000—No. 1, 1; No. 2, 1.10; No. 3, 1.15.

All the above specimens of water show a marked degree of bacterial infection, and in their present condition are unsafe for drinking purposes.

Very truly, WILLIAM HAILES, Jr.

Each year the rapid growth of the village brings nearer together the abodes of the living and the dead. The cemetery is only three-fourths of a mile from the business portion of Nyack, and lies partially within the corporation limits on a hill sloping abruptly to the south, and more gently to the east and southeast. At the foot of the southern slope, and within 500 feet of many graves, is an ice pond covering several acres, the elevation of the graves ranging from 60 to 100 feet above the surface of the water. Between the cemetery

and the pond are eight dwellings, while on the east adjoining is a large boarding school. All these houses are supplied with drinking water from wells or springs on this slope. The first interment in the cemetery was in 1848, and there are now over 4,000 bodies buried within an area of about eighteen acres.

NEWS OF THE WEEK.

Contracting.

R. R. Contract.—Geo. Arnold & Co., of Memphis, Tenn., have the contract for constructing the Natchez, Red River & Texas R. R., from Vidalia, La., to Trinity Miss.

The Channel Tunnel is again being agitated. The SouthEastern Railway Co., and the Submarine Continental Railway Co., announce that they propose to introduce a Bill to enable them to continue the experimental works of shafts, tunnel driving, etc. If these works prove the scheme practicable, the Lords of the Treasury are to have the right to determine whether it is expedient to sanction the permanent construction.

Steel Contract.—A steel contract of considerable extent (*Kuhlow's states*) has been given out by the Bromberg Railway Administration, for about 10,000 tons or 200,000 centners of steel rails, 16,700 centners of rail fish plates and 3,000 centners of underlaying plates. The tender of the Oberschlesische Eisenbahn-Bedarfs-Gesellschaft of 146 marks per ton from Morgenroth was considerably higher than those of Rhenish-Westphalian works, of which the Union Company in Dortmund tendered 138 marks, the Phœnix at Laar 132.70 marks, and the Bochumer Verein 132.80 marks from the station. Nothing is said of the tender of Laurahuette, and it is quite probable that the contract was reserved for Rhenish-Westphalian works, whose prices scarcely reached those offered in October for the Strassburg contract. Steel fish plates were offered unusually cheap in the Bromberg tenders, Laurahuette tendering 89.70 marks, the Bochumer Verein 86 marks, and the Hasch Steelworks, Dortmund, 87.50 marks.

The Growth of Brooklyn.—The following figures tell the story of the growth of Brooklyn since 1874, when the statistics were first collected upon the organization of the Building Department of that city:

Year.	No. of Permits.	No. of Buildings.	Cost.
1874	1,344	972	$ 5,152,150
1875	1,618	1,542	7,364,950
1876	1,743	1,687	6,999,210
1877	1,708	1,584	6,892,145
1878	1,748	1,878	8,330,170
1879	1,703	1,517	6,043,205
1880	1,705	1,585	6,839,740
1881	2,005	1,915	8,632,531
1882	2,375	1,934	8,590,506
1883	2,688	2,846	13 100,024
1884	3,050	2,739	12,672,344

The above figures are official; according to our own records, the expenditure for new buildings in 1884 was $14,370,714. Thus far in 1885, that is to November 27th, the cost of new buildings is $18,643,197. The probabilities are that fully $20,000,000 will be spent on new construction in our sister city, against some $45,000,000 or $46,000,000 on this side of the East River. These statistics show very rapid progress, especially since the Bridge was opened.—*The Record and Guide.*

New Method of Sewer Building.—The *Scientific American*, of Dec. 12, has an illustration of the method devised by Anderson & Barr, for building a sewer by tunnelling through a deep sand formation. The sewer is 12 feet in diameter, inside, with a minimum thickness of 12 inches of brick; some portions of the work are 64 feet below the surface. The contractors use the "pilot" tunnel designed by John F. Anderson, and first employed at the Hudson River Tunnel, and already described in this journal. This "pilot" is 5½ feet in diameter, and is made of interchangeable plates with inside flanges; it is pushed ahead of the sewer tunnel near the center line, and as the front end rests in undisturbed ground, the rear portion is used as a point of support for the bracing used inside the masonry. The pilot is advanced by removing the rear plates, taking them forward inside, and setting them up again in the newly excavated portion. The brick masonry of the sewer is also built inside of a plate-iron shield similar in construction to the "pilot," and supported from it by radiating struts until the masonry is in place; the sewer shield proper is usually only used over the upper half of the tunnel, and the plates are left in over the masonry.

Removing the Remains of Flood Rock.—The men and machines of the Atlantic Dredging Co. are digging away diligently at Flood Rock. Three thousand tons of rock, or one-tenth of the amount of their contract, have been removed. The work is of about the same character as that done at Hallett's Point by the same company. The excavation has extended down among the original drill holes and will soon break into the galleries. The rock is fissured and shattered, but a liberal use of dynamite is necessary to get it into pieces of such a size and position that it can be grappled with successfully. At present as much explosive material is being used per cubic yard as was employed in the original blast. The cartridges used weigh from fifty to one hundred pounds. The divers are working in from the extremity of the reef, and when that portion of the Nigger Head which is out of water is reached still greater difficulties will probably be encountered. The rest of the reef, however, is expected to prove more tractable. A fact that promises easier work in the future is that the depth of twenty feet has not been exceeded as yet. The remaining six feet of rock, upon which the dynamite acted most directly, should present less serious resistance to removal.

Commissioner of Accounts Shearman was before the Gibbs Committee on Dec. 8. For several weeks he has been preparing statements from the city's records to show the workings of the system of unbalanced bids in contracts led by the Department of Public Works, and he told the committee what he had found out. From March 30, 1882, to Feb. 16, 1885, he said, the Department of Public Works, through the Bureau of Street Improvements, made 98 contracts, of which 84 were completed and 74 are in progress. These 84 contracts were estimated by eleven surveyors, who were employed by the Public Works Department, at $698,761.02. The actual cost when the work was done, however, was $906,996.54, showing as an excess of cost over estimate $208,232.52. In the actual cost are counted the surveyors' fees, which were $20 248.23. In 32 of these 84 contracts the actual cost was $2,397.26 less than the estimated cost. In the 52 contracts in which the cost was greater than the estimated cost, 18 contracts exceeded the estimate over 10 per cent.

The estimated cost of these contracts was $15,526.25, and the certified cost was $117,395.68, an excess of $101,869.40, or 656.10 per cent. This contract is now in the Superior Court for settlement. John Brady, the contractor, having sued the city for a claim which, if allowed, will raise the $117,395.68 to $179,659.68, and will make the cost over estimate jump to 1,057 per cent. The work done under this contract was on Riverside drive in July, 1883. The surveyor was H. K. Viele; the inspector J. R. Mount.

Mr. Shearman produced a table which showed the percentage of quantities of each kind of work covered by contracts in charge of each surveyor. The object of the table is to demonstrate that some form of contract should be adopted to do away with unbalanced bids. In this table are the following statements:

H. K. Viele, three contracts. Estimated cost, $64,638.29; cost, $173,362.13; increase, $109,323.84; percentage of increase, 170.70.

C. H. Haswell, three contracts. Estimated cost, $17,329.90; cost $25,085; increase, $7,755.64; percentage of increase, 30.90.

T. & J. Slater, one contract. Estimated cost, $4,622.10; cost, $15,070.40; increase, $10.448; percentage of increase, 226.—*N. Y. Sun.*

Railroads, Bridges and Canals.

Progress of Work on the Panama Canal.—PANAMA, Dec. 11, via Galveston.—The present condition of projected interoceanic canal across the Isthmus is described as follows by the officials of the company: "Operations are under way on two-thirds of the entire length of the proposed canal. The other third will be the easiest of all to excavate, as it is composed of soft earth only. Active preparations are being made for beginning work in this section, and the erection of machinery is now in progress. Excavations are in progress along the line of the canal proper, and also for changing the obstructive water courses. Excavators for the Culebra section are now being disembarked. If these excavators in actual pratice prove to possess only one-fourth the horse-power they displayed when on trial, they will be sufficient to excavate the bulk of the Culebra section in less than three years. The number of laborers now employed is 12,000, and it is the purpose of the company to double this number during the dry season. Work will then proceed upon all sections. The inundations of the Chagre river this season have caused only slight damages to the work in progress."

Concessions to the Eads Ship Railway.—A telegraphic message received on Dec. 11 from President Diaz of Mexico to the President of the Tehuantepec Ship Railway Company, announced the passage on Dec. 10 by the Mexican Congress of the amended concessions to the company. These amendments add to the previous land grant 1,700,000 acres, the whole land concession being equal to half the area of New Jersey. Coaling stations are to be permitted at either end of the railway to which coal from the United States or any other foreign nation coöperating with Mexico in guaranteeing interest on the bonds of the railway company, is to be admitted free, to the exclusion of coal from all other countries. This will give a new market to the United States coal trade if the United States Congress joins with Mexico in the guarantee on which the bonds to build the ship railway are to be based. Mexico guarantees the payment of $2,500,000 a year for fifteen years, provided this or some European nation guarantees $2,500,000 more for the same period. The time for completing the road has been extended to 1894.

Bids on a 44-foot Rolling Draw-Span.—Capt. Wm. H. Bixby, U. S. Eng'rs., of Wilmington, N. C., sends us the following statement of proposals for a 44-foot single-roadway rolling draw-span: Bids were opened December 7th; the bidders being: H. A. Ramsey, Baltimore Engineering Works, Baltimore, Md., $1,900 for the rolling span alone; Samuel W. Skinner, Wilmington, N. C., $4,467 for bridge complete; King Iron & Bridge Manufacturing Co., Cleveland, Ohio, $5,868 for bridge complete. The bridge as described in the specifications was to support a single rolling load of ten tons, and have two approaches of 60 and 120 feet length respectively, and was to be put across Mosquito Creek, Georgetown, S. C. The clear passageway for teams was 10 feet wide and 13 feet high; the bridge when open to leave a boat-passage of 40 feet; and the turning apparatus so arranged that one man can open it in two to four minutes. The approaches at the channel-end were to be of four piles, 14 inches diameter and 35 feet long, encased with cement and cast-iron cylinders over 18 feet long. The supports of the rolling-span to be protected by at least twenty piles, 12 inches diameter and 28 feet long. The remainder of the approaches may be on piles 20 feet long.

The West Shore R. R.—ALBANY, Dec. 7th.—The articles of incorporation of the new West Shore Road name the following directors for the first year: Ashbel Green, Tenafly, N. J.; Charles Lamer, Edward King, Edward D. Adams, J. Hood Wright, Charles H. Coster, George S. Jones, Howard Mansfield, Herbert E. Kinney, Charles Edward Tracey, George W. Knight, Francis Gordon Brown, New York City, and Joseph P. Ord, of Englewood, N. J. The agreement for reorganization is set forth very fully the plan being that a reorganization committee of three shall be appointed with authority to purchase the entire railroad, appurtenances, equipment, franchises, etc., of the West Shore Company at any sales to be made under judgments or decrees in suits for the foreclosure of its mortgage for $50,000,000, or under the direction of trustees therein named.

If such purchases be made, a new corporation is to be formed, to be called the West Shore, in which shall be vested the franchise and the property, subject to the provisions made as to the branch from Cornwall to Middletown. The new corporation may acquire, with the approval of the reorganization committee and the Central Railroad Company, railway, terminal, and ferry property interests and such other properties and interests as may be deemed necessary for the security, development and operation of its property under the lease with the Central. The reorganization committee are J. Pierpont Morgan, Chauncey M. Depew and Ashbel Green. This committee are given power to supply every defect in the plan or execute a more detailed or modified plan. They are not required to make any cash payments or advances out of their funds and are entitled to reasonable compensation.

The new company is to assume all the liabilities of the committee connected with the sale and purchase. To resign, a member of the committee must give ten days notice. The committee are empowered to make any agreement with the New York, Ontario and Western Railroad Company with respect to any property and interests which the company may have in the property now acquired, and exclude the branch from Cornwall to Middletown from the conveyance to the new corporation, and cause it to be conveyed to the Ontario and Western.

The capital of the new company is $10,000,000 in $100 shares. Bonds not exceeding $50,000,000 are to be issued, payable 475 years from January 1st, 1886, or upon default in payment of interest for two consecutive years, and bearing interest from January 1, 1886, at 4 per cent. per annum, payable semi-annually. So many of the bonds as shall issue are to be endorsed with the guarantee of the lessee company of punctual payment. The bonds are also to be secured by a first mortgage to be executed by the new company to a trustee to be named by the Reorganization Committee, covering all the railroad property, etc., excepting the Cornwall-Middletown branch. The lease is to be for 475 years to the New York Central, with privilege of renewal for 500 years.

Launch of a Pontoon at the New Tay Bridge.—On November 20 the Messrs. Arrol, contractors for the new Tay Bridge, launched the first of two large pontoons from their yard at Buckingham Point, Dundee. The pontoon is rectangular in shape, 80 feet long, 28 feet broad, and 8 feet 6 inches deep, with two "stools" on deck for bearing girders. It weighs about 100 tons, and is fitted with steam winch and other appliances. The pontoon will be employed, along with a second one of the same size, which is to be launched this week, in floating out the 245 feet girders from the jetty at Wormit to the piers in the center of the river. The pontoon was built on the ground, and after being completed was raised by hydraulic appliances to the necessary height for clearing the wall of the Esplanade. Launching ways were then laid underneath it and across the promenade into the water. When all was ready the triggers were struck, and the pontoon glided smoothly into the water. Two steamboats were in attendance, and towed the pontoon to Wormit, where it will remain till the second is ready. The two sets of

girders at Wormit, which are now ready to be placed on the piers at the gap, will be floated out as soon as the pontoons are ready. Satisfactory progress is being made with the works at the bridge. At the gap, where it was expected extraordinary difficulties would be met with, the work of sinking the cylinders is being carried on very expeditiously, piers being put down at the rate of one in five weeks. At the north end the work of laying the girders is advancing rapidly, and the superstructure at the south side is also making a good appearance.

The Central Missouri.—Another railroad is contemplated, its route being to add another connection between St. Louis and Kansas City with a branch line to Hannibal, Mo. It is to be known as the Central Missouri Railway, and the capital stock, at present $3,000,000, is to be increased to $10,000,000 when the charter to build is granted and construction begun. The Directors in the new company are: Geo. I. Post of Fair Haven, N. Y.; J. T. K. Hayward, L. C. Nelson and John W. Harrison of St. Louis, Mo.; Henry G. McPike and Henry R. Phinney of Alton, Ill.; Edwin H. Allen, Thos. B. Bullene and Edward L. Martin of Kansas City, Mo.; John H. Garth and Jas. T. Barker of Hannibal, Mo.; and Wm. Ely of Perry, Mo. The officers are: Geo. I. Post, President; J. T. K. Hayward, Vice President, and L. C. Nelson, Secretary and Treasurer. The new road is to begin at East St. Louis, run thence to Alton, Ill., where it crosses the Mississippi, finding there a favorable place for a bridge, and continues westward in the valley of the Missouri river, near the northern bluffs, until it reaches the opposite bank of the river at or near Arrow Rock. Here another crossing is made. The grade between Arrow Rock and St. Louis, a distance of 2,000 miles, averages one foot to the mile, with no point with a grade above 10 feet to the mile.

Western Union Telegraph Statistics.—Mr. Somerville, who has charge of the press service of the Western Union Telegraph Company, gave some instructive figures as to the growth of that business, and the changes that have resulted from growth and from competition in the rates charged for the service. The total amount of press telegrams, including the Associated Press service, sent over their wires now reaches a thousand million words a year. The telegraph year for the transaction of business closes on July 30. In 1879, for the year, there were transmitted of special messages 32,000,000 words; in 1880, 55,000,000; in 1284, 112 000,000; in 1885, 120,000,000. The steady growth of the special service shows the degree in which the leading newspapers are coming to rely on gathering their own news. There has been a great change in the rates for service. In 1879 the average was $1.87 per 100 words: now it is 57 cents per 100. In England, where the distances are short, the average rate on special dispatches is half a cent a word. The Associated Press is carried at an average of 14 cents per 100 words for each place. In England the rate is 25 cents, with an extra charge for certain advantages, which brings it up to 27 cents. When Mr. Somerville took charge of this branch of service in 1879, the rate to the Pacific Coas was 10 cents per word; now it is 1¾ cents to San Francisco, and only 2 cents to the furthest point on the coast. Th is the highest rate anywhere made. Similar changes have been made in the rates between other points in some instances probably due to competition. The old Chicago rate was 3 cents from New York; now it is half a cent. Washington was 1 cent, and is now one-fourth of a cent. A great many papers lease special wires by the year. The Western papers take large quantities of matter nightly from New York. The figures given relate only to the service over Western Union wires. The other telegraph lines of the country carry about one-third as much more.—*N. Y. Tribune.*

Miscellaneous.

Guns and Armor Plate.—The special Ordnance Committee, which spent some time this summer visiting iron and steel mills for the purpose of ascertaining their capacity in the manufacture of guns and armor plate, met on the 4th and discussed their report. No definite conclusion was reached, but the unanimous opinion of the members was that the Pennsylvania mills, with the enlargements their proprietors were willing to make, would be fully sufficient to meet the Government's demands.

The Pennsylvania mills had attracted almost the entire attention of the committee, and most of their testimony related to them. The Cambria Iron and Steel Works, at Johnstown, were found to be wonderfully well suited to all kinds of steel work, and several mills in Pittsburg, particularly Moorhead and the Spang Steel Company, were found to be willing and evidently able to undertake the manufacture of steel plates. They also understood that the Bethlehem Works and eastern Pennsylvania concerns were equally able to undertake any orders that the Government had to give.

A METHOD has been patented by a Buffalo man for thawing out frozen hydrants, which may be of great service in case of fire. The hydrant is fitted with a small pipe, which passes below the frost level into a sewer, the top being covered with a cap. This tube is, of course, empty of water, and by forcing steam through it the hydrant can be quickly thawed out.—Buffalo *Express.*

THERE is abundant reason for believing that the earth's crust is very thin, asserts Mr. J. Starkie Gardner, and it seems not impossible that some means may be devised for utilizing the intense heat of the mass below. This is already being done, in fact, to some extent, an artesian well having been bored at Pesth to obtain warm water for public baths, etc. From a depth of about 3,000 feet a large quantity of water heated to 161 degrees Fahrenheit pours forth, and the boring is to be continued until water at 178 degrees is yielded.

Recent Patents.

Car Starters.—*William P. Vickery, East Auburn, Maine* The pole is connected by a lever with a pinion engaging with a segmental rack on one of the car axles; the starting pull on the pole tends to turn the wheels in a forward direction. No. 330,946.

Henry H. Watson, Waltham, Mass. The axles rest in a housing with a longitudinal slot, giving play to the axles; the starting pull operates first to move the axle and frames before the car body is moved. No. 331,220.

Ditching Machines.—*Francois X. Lemay, Crookston, Minn.* A frame carrying the engine has a scoop or mold-board at its rear end, with rising and falling spades to cut the soil in the scoop, and having a backward movement. An endless belt conveys the soil from the scoop to a receptacle travelling with it. No. 330,909.

Samuel M. Stewart, McComb, Ohio. The frame carries a series of revolving cutters, with scoops or undercutters in front, and dirt-elevating wheels The supporting wheels are adjustable. No. 331,217

Method of Constructing Jetties.—*John C. Goodridge, Jr., New York, N. Y.* A hollow shell, with a loose filling of brush, hay, sand, etc., has a flexible mattress in overlapping sections interposed between the bed of the stream and the filling. Fascines also used. No. 331,127.

Weir and Sluice.—*Mitar D. Cvetkovics, Vienna, Austria-Hungary.* An arrangement of hatches sliding one within the other vertically, and attached to long rods pivoted on a common center. An arrangement is provided for automatically lowering the hatches in case of flood. No. 331,038.

Market Report of Engineering Materials.

New York, December 17, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles	1.90	@	2.00
Tee	2.25	@	2.35
Beams and channels American	3.0c.	@	
Tank	2.	@	2.1c
Shell	2.4c.	@	2.5c
Steel plates, Tank	2½c.	@	
WROUGHT-IRON PIPE., PITTSBURGH.			
Butt welded, black ... Discount	42½	@	45
" " galvanized ... "	32½	@	35
Lap welded black ... "	60	@	62½
" Galvanized ... "	45	@	42½
Boiler tubes ... "	55		
RAILS.			
Steel (large lots at mill)	34.00	@	35.00
Old rails	19.00	@	20.00
Old railsteel	19.00	@	20.00
R R. spikes	2.25		
R R. splice-plates	1.70	@	1.75
R R. Track Bolts Square Nuts	2.75		
Barb-wire fencing, galvanized			4.75
" painted			3.75
Corrugated iron			
Nails			
Iron, per keg	2.65	@	2.75
Steel do.	2.50		

METALS.

COPPER.			
Lake Superior	11.30	@	11.50
Other Brands	10.25	@	10.50
LEAD.			
Com. Domestic			4.60
Lead Pipe	.06¾		
Tin-Lined Lead Pipe	.15		
Sheet Lead	.07½		
ZINC.			
Sheet	5.30	@	5.60

BRICK.

Cargoes afloat)			
Haverstraw ... per M.	$6.00	@	6.25
Fishkill			
Up-River	5.75	@	6.25
Jerseys	5.25	@	6.00
Long Island			
" pale	2.75	@	3.50
FRONTS.			
Croton, red	11.00	@	14.00
" dark	11.00	@	14.00
" brown	10.00	@	13.00
Philadelphia pressed	24.00	@	25.00
Trenton "	24.00	@	25.00
Baltimore "	37.00	@	41.00
Buff "	33.00	@	35.00
Enameled English	65.00	@	130.00
" American	85.00	@	120.00
Fire brick	25.00	@	45.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

BAETJER & MEYERSTEIN:			
Hanover Port.and	$2.60	@	$2.65
BELLONI & Co.:			
Hemmoor "Crown" brand			2.50
JAMES BRAND:			
K. B. & S	2.55	@	3.00
BROOKS, SHOOBRIDGE & Co.	2.45	@	2.60
HOWARD FLEMING:			
Gibbs' English Portland, 400 lbs	2.65	@	2.90
K. B. & S. " "	2.75	@	2.95
Stettiner, German	2.65	@	2.85
Lagerdorfer, "	2.45	@	2.75
Fieve, A 1, Belgian	2.35	@	2.50
Roman	2.75	@	3.00
Keene's Coarse	4.75	@	5.50
" Fine	7.75	@	8.50
" Superfine	8.50	@	10.00
FISHER, EBSKINE W.:			
Stettin (German) Portland Cement	$2.40	@	2.75
GABRIEL & SCHALL:			
Vorwohler "Lion"	2.65	@	3.10
HUDSON RIVER CEMENT Co. Rosendale			1. 0
JOHNSON & WILSON:			
Saylor's American Portland	2.15	@	2.40
LAWRENCE CEMENT Co.:			
Hoffman Rosendale			
LESLEY & TRINKLE, Philadelphia, Pa.:			
"Giant" Portland	2.20	@	2.40
Improved "Union"	1.25	@	1.50
Union	1.10	@	1.20
MARCIAL & Co.:			
J. B. White & Bros. Coarse	4.50	@	5.00
" Fine	8.00	@	10.00
" Portland	2.45	@	2.85
NEW YORK CEMENT Co.:			
Rosendale			1.20
N. Y. & ROSENDALE CEMENT Co.:			
Rosendale, "Bridge" brand			1.10
SINCLAIR & BABSON:			
Alsen's Portland	2.45	@	2.75
K. B. & S.	2 35	@	2.60
STANDARD CEMENT Co.			
E. THIELE:			
Dyckerhoff	2.90	@	3.25
UNITED STATES CEMENT Co.:			
Windsor	1.00	@	1.10
Standard			1.15
Cable's Portland	2.15	@	2.40
UNION AKRON CEMENT Co.:			
Akron "Star" brand.			

ASPHALT.

Prices range per ton	$15 00	@	20.00
According to quantity or brand, and whether taken from vessel or store.			

LIME.

Rockland, common per bbl	1.00		
" finishing	1.20		
State, common	.90		
" finishing	1.10		
Kingston, ground	95	@	1.00
Add 25c. to above figures for yard rates.			

STONE.

Cargo rates at New York.			
Amherst freestone, No. 1 per cub. ft.	0.90	@	0.95
" " No. 2 "	0.75	@	0.80
" " light drab "	0.80	@	0.95
Berlin " in rough "	0.75	@	1.00
Berea " " "	0.75		
Brown stone, Portland, Ct. "	1.00	@	1.30
" Belleville, N. J. "	0.75	@	1.25
Granite, rough	0.60	@	1.25
Common building stone per load	2.00	@	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@	3.00

SLATE.

Purple roofing per square	6.00	@	7.00
Green "	6.00	@	7.00
Red "	15.00		
Black Penna. (at New York) "	4.50	@	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@	20.00
Choice	65.00	@	70.00
Tally plank, 1¼ in. 10 in. dres'd, each	.44	@	.50
Tally boards, dressed com. "	.28	@	.30
SPRUCE, Boards dressed "	.25	@	.28
Plank, 1¼ in "	.28	@	.30
" 2 in. "	.38	@	.40
" 2 in. dressed "	.43	@	.45
Timber per M.	20.00	@	22.00
HEMLOCK, Boards each.	.18	@	.20
Joist, 2¼ × 4 to 4 × 6 in	.16	@	.44
OAK per M.	55.00	@	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00	@	40.00
YELLOW PINE, Girders "	25.00	@	30.00
Dressed flooring "	28.00	@	35.00
SHINGLES, Extra shaved pine, 16in. "			
" sawed 18 in. "	5.75	@	6.00
LATH, Cargo rs "	2.25	@	2.30

PAINT.

Lead, white, American dry per lb	.04¾	@	.05
" in oil pure "	.05½	@	.06
English, B. B. in oil	.08½	@	.08¾
Red, American	.05¼	@	.05½
Litharge "	.05	@	.05½
Venetian red, American "	.01	@	.01¾
Indian red "	.05	@	.10
Vermillion, American lead "	.11	@	.11¾
Paris green "	.15	@	.20
Umber, Amer. raw and powdered per lb.	.01¾	@	.01¾
Drop black, Amer.	.07	@	.13
" " Eng.	.11	@	.13
Chrome green	.05	@	20
Oxide zinc, American	.03¾	@	.04
" French	.06¾	@	.08